ZEXEL

FOREWORD

Although the passenger car market has to date been almost monopolized by cars powered by gasoline engines, the advantages of cars powered by diesel engines were recently re-evaluated from the standpoints of fuel availability and economy. As a result, the demand for cars powered by diesel engines has been increasing. Diesel engines capable of coping with particular local conditions have also been developed and are now being marketed.

Accordingly, various additional devices for fuel injection pumps have been developed for these engines.

This service manual has been prepared to help service personnel provide quick, effective service and maintenance of these devices.

All information, illustrations, specifications and part numbers contained in this manual are the latest available at the time of printing.

The right is reserved to make changes in specifications and procedures at any time, without notice.

GENERAL

The following describes the special tools (used in addition to general tools) and procedures that should be commonly used to service the fuel injection pumps.

The numbers in brackets ( ) following part names and tool names in each description are the key numbers of the parts shown in each exploded view of the additional devices and the part numbers of the special tools.

Special Tools for Disassembly and Reassembly

No.	Part No.	Part Name	Q'ty	Remarks
1	KDEP 2919	Universal vise	1	Used with brackets (KDEP 2985 and KDEP 2963)
2	KDEP 2985	Bracket	1	For fixing bracket (KDEP 2963)
3	KDEP 2963	Bracket	1	For fixing injection pump
4	commerc. available	Bolt	1	For fixing bracket (KDEP 2985)

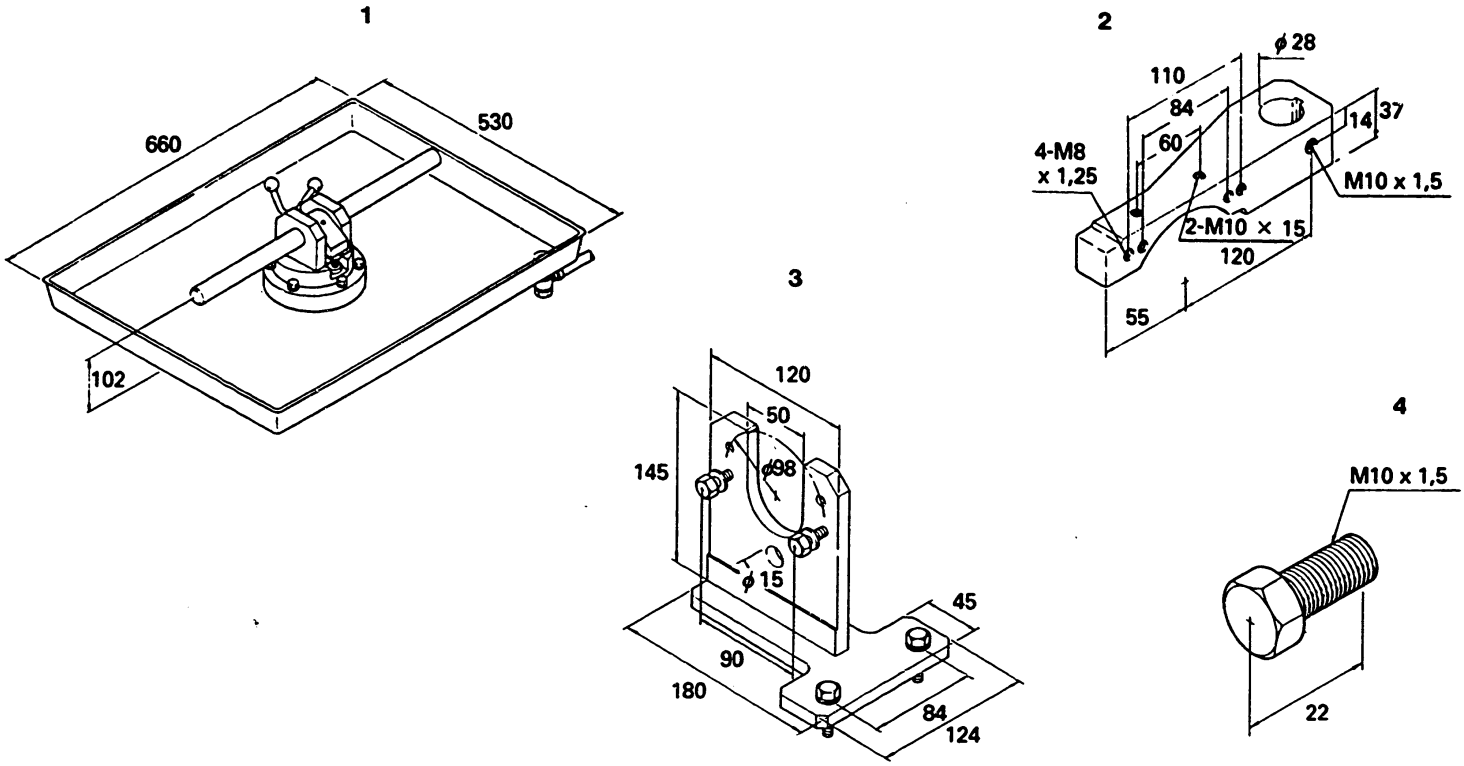


Fig. 1 Special tools for disassembly and reassembly

1 = Universal vise

2 = Bracket

3 = Bracket

4 = Bolt

Disassembly

Keep the workbench clean and tidy. Before disassembly, clean completely the outside of the injection pump assembly, record the positions of the adjustable parts to facilitate reassembly and record the injection pump performance so that a comparison may be made after adjustment.

Preparation

1. **Fix the bracket (KDEP 2985) to the universal vise (KDEP 2919) using the bolt.**

2. Before attaching the injection pump to the bracket, remove the overflow valve or solenoid timer to drain the fuel oil from the injection pump chamber.

Reassembly

As reassembly procedures are generally the reverse of disassembly procedures, only points requiring particular attention are described in "Reassembly".
All removed O-rings, gaskets and oil seals must be replaced with new ones.

Special Tools for Adjustment

No.	Part No.	Part Name	Q' ty	Remarks
1	1 688 010 011	Fixing stand	1	For mounting injection pump on test stand (center height: 110 mm).
2	1 688 010 129	Fixing stand	1	For mounting injection pump on test stand (center height: 125 mm).
3	1 685 720 062	Flange	1	Adapter for mounting injection pump on test stand.
4	1 686 430 022	Coupling	1	Used for driving injection pump (17 mm diameter drive shaft, 3 mm key groove).
5	1 686 430 024	Coupling	1	Used for driving injection pump (20 mm diameter drive shaft, 2,5 mm key groove).
6	1 686 430 023	Coupling	1	Used for driving injection pump (20 mm diameter drive shaft, 4 mm key groove).
7	0 681 443 014	Test nozzle	- 6	For adjusting injection pump.
8	1 688 901 013	Test nozzle holder	6	For adjusting injection pump.
9	1 680 750 017	Injection pipe	6	For adjusting injection pump (2 mm x 6 mm x 840 mm, M12 x 1.5 - M14 x 1.5).
10	commerc. available	Pipe assembly	1	For fuel piping to pressure gauge.
11	commerc. available	Bolt	1	Adapter for fuel piping to pressure gauge.
12	1 688 130 139	Measuring device	1	For measuring timer stroke (mounted on high pressure side).
13	KDEP 2601	Measuring device	1	For measuring timer stroke (mounted on low pressure side).
14	KDDC 0021	Measuring device	1	For measuring timer stroke (mounted on low pressure side).

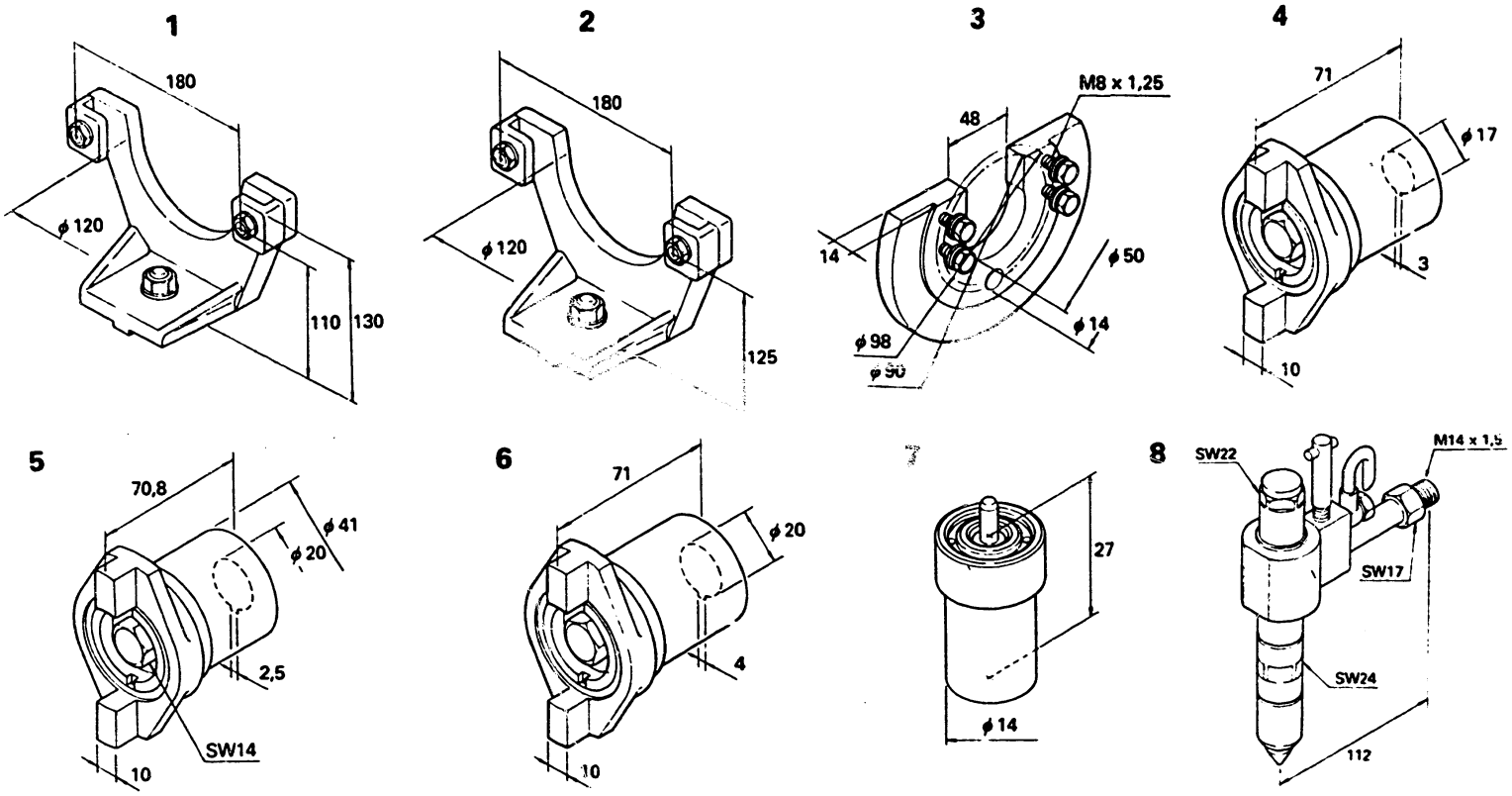


Fig. 2 Special Tools for Adjustment

1 = Fixing stand
2 = Fixing stand
3 = Flange
4 = Coupling
5 = Coupling
6 = Coupling
7 = Test nozzle
8 = Test nozzle holder

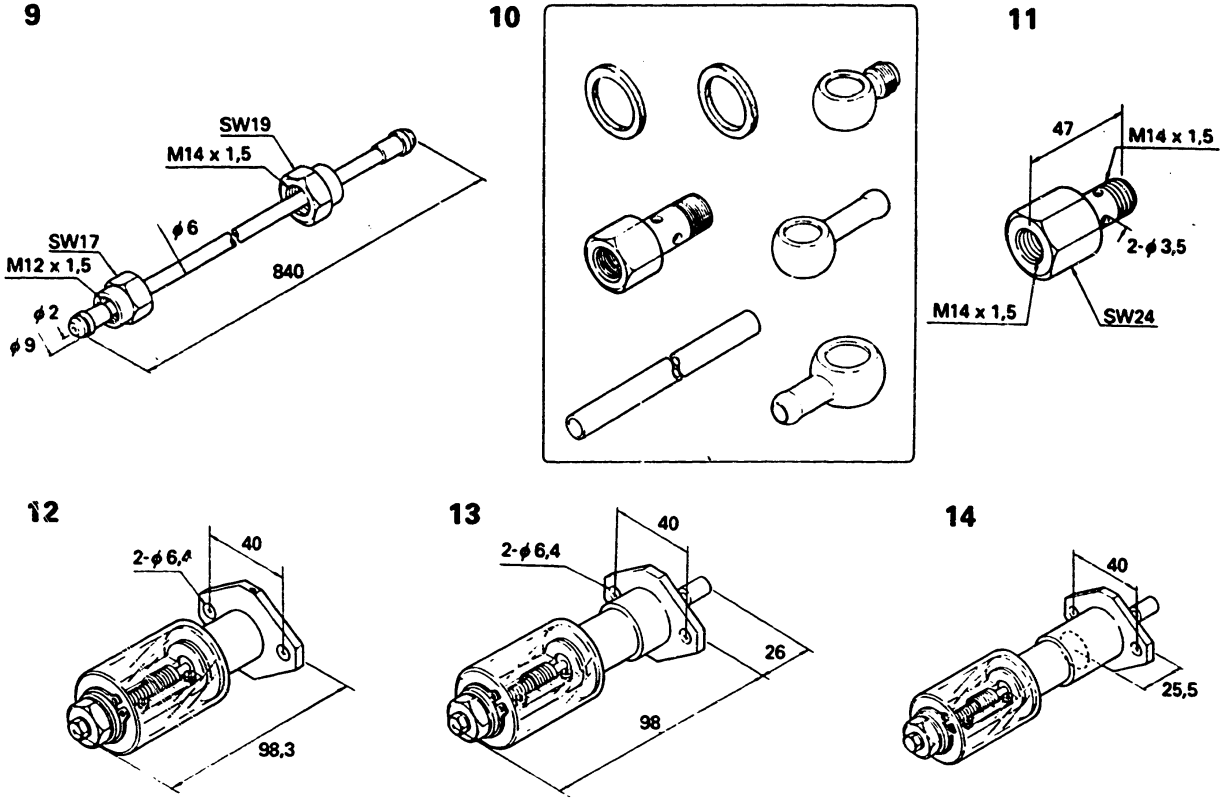


Fig. 2-1 Special Tools for Adjustment

9 = Injection pipe
10 = Pipe assembly
11 = Bolt
12 = Measuring device
13 = Measuring device
14 = Measuring device

Adjustment

Perform injection pump adjustments based on the calibration data.
The injection pump adjustments, other than those for an additional device, are the same as those for a conventional injection pump and therefore only the adjustment of the additional device is described in "Adjustment"

Preparation

1. Fit the key in the drive shaft and attach the coupling. Then, mount the injection pump on the fixing stand and connect it to the injection pump tester.
2. Connect the fuel and injection pipes (refer to **Fig. 3)**.
3. Perform the running-in operation (refer to VE R & M service manual).

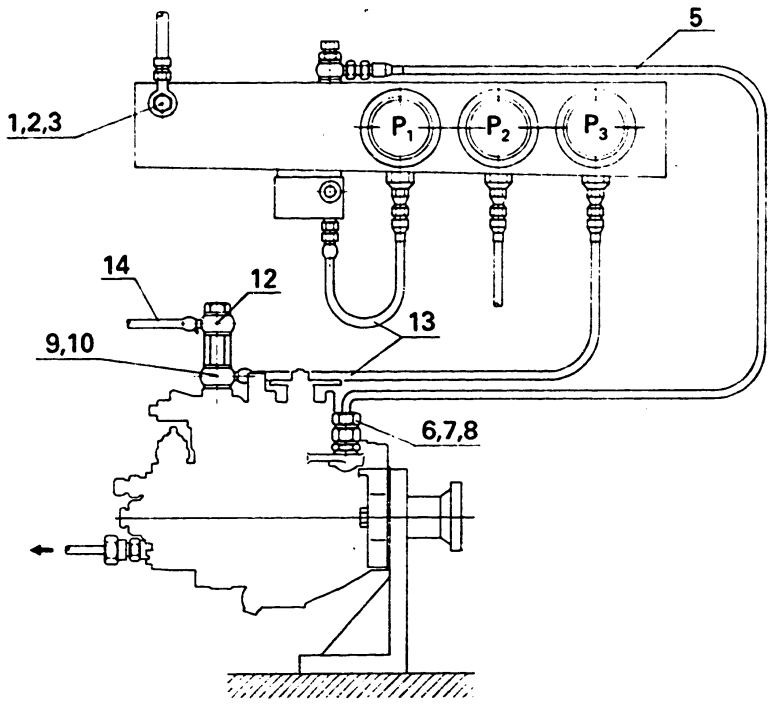


Fig. 3 Fuel and injection piping

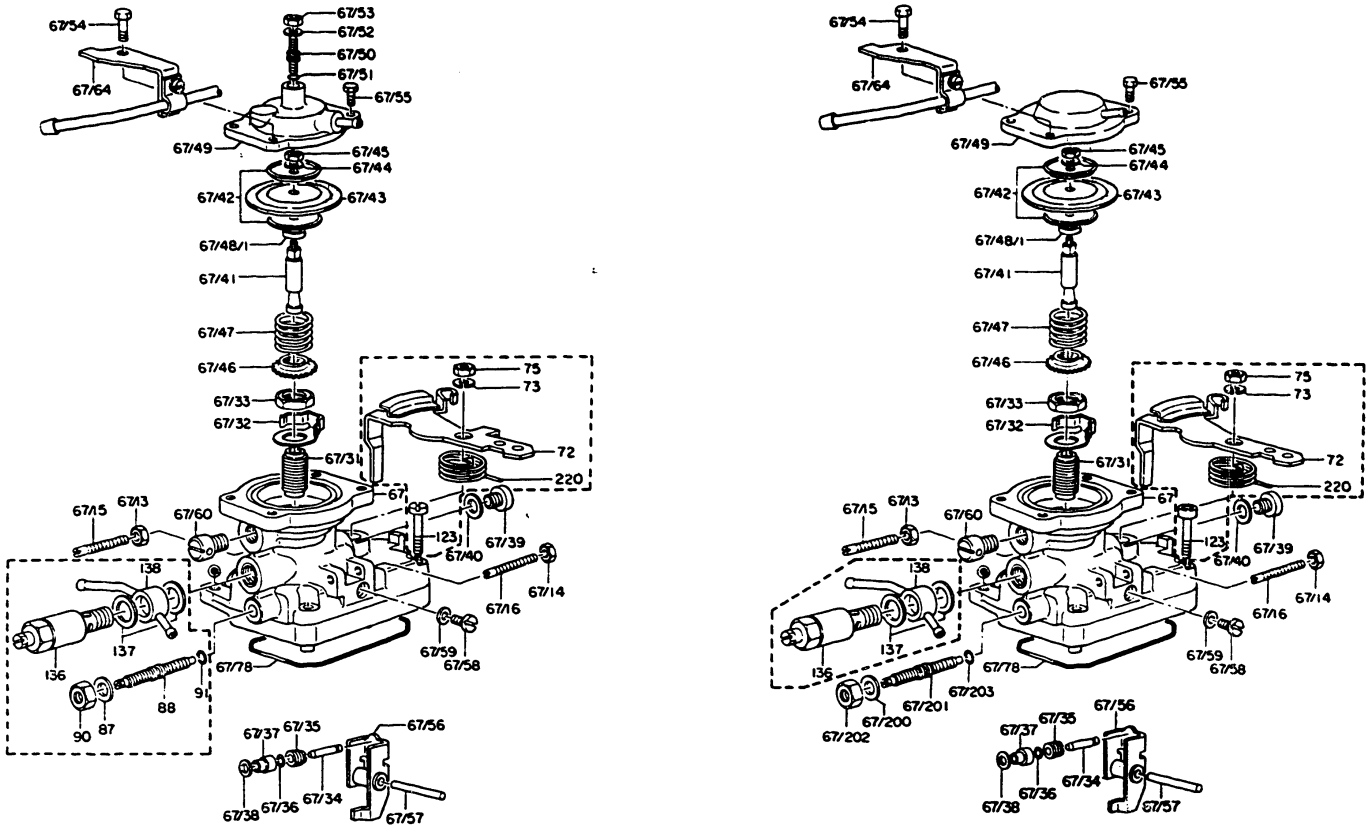


Fig. 4 Boost compensator: exploded view

BOOST COMPENSATOR

Figure 4 shows an exploded view of the boost compensator.

Special Tools for Disassembly and Reassembly

No.	Part No.	Part Name	Q'ty	Remarks
1	KDEP 2615	Pin	1	For extracting boost compensator lever pin
2	KDEP 2617	Guide pin	1	For holding screw bushing
3	KDEP 1152	Block gauge	1	For adjusting boost compensator lever position
4	KDEP 2616	Adjusting cover	1	For adjusting diaphragm assembly position

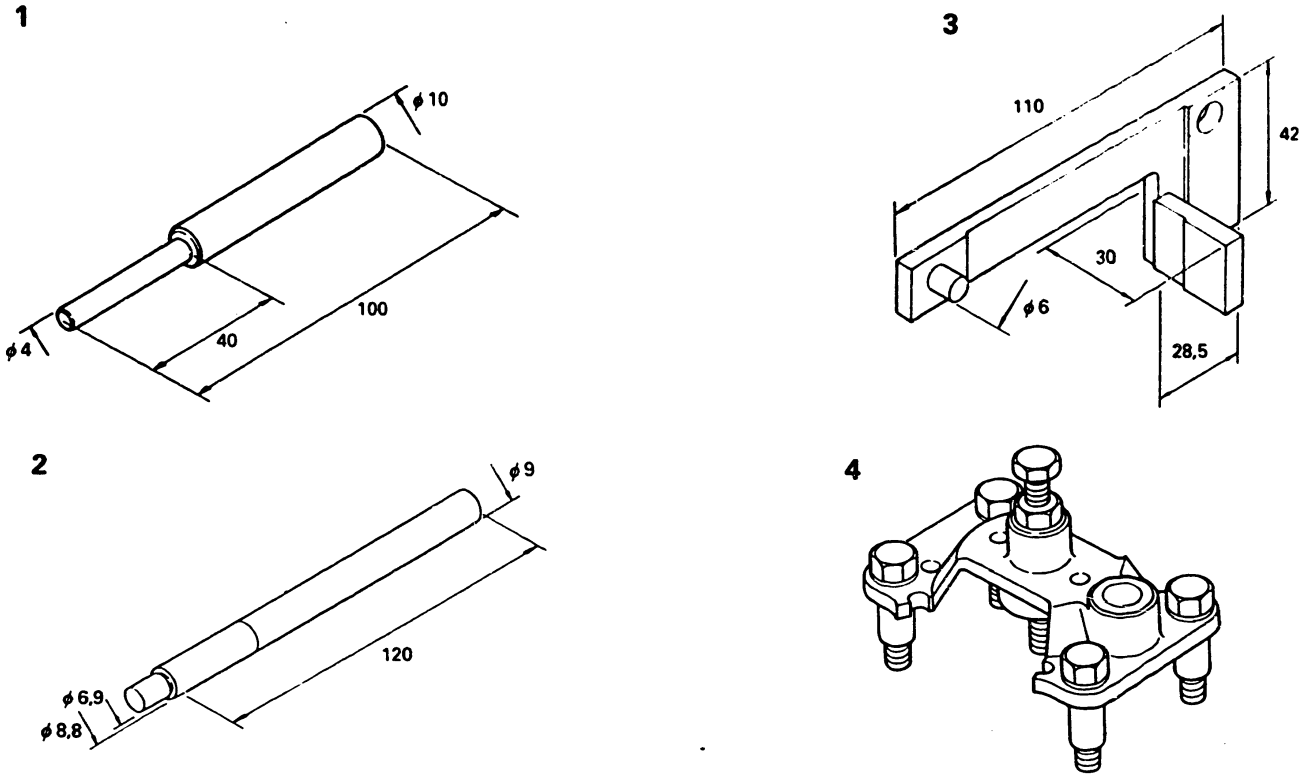


Fig. 5 Special tools for disassembly and reassembly

1 = Pin

2 = Guide pin

3 = Block gauge

4 = Adjusting cover

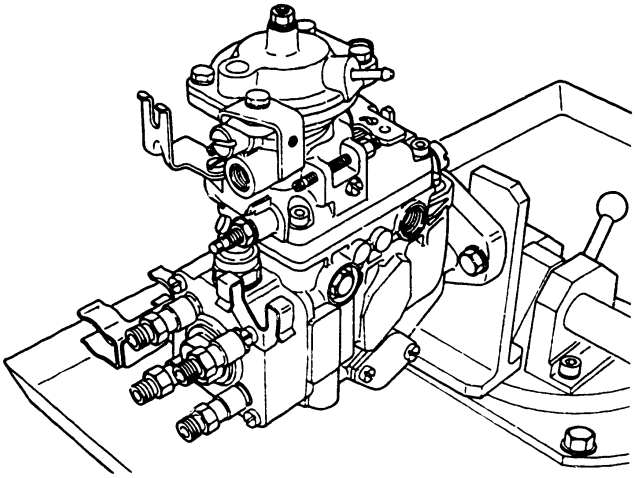


Fig. 6 Attaching the injection pump

Disassembly

1. Attach the injection pump to the bracket (KDEP 2963) using the two bolts.

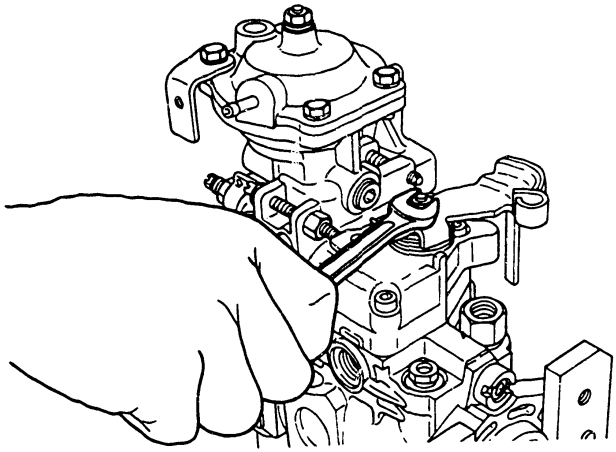


Fig. 7 Removing the nut and spring washer

2. Remove the nut (75) fixing the control lever (72) and the spring washer (73).

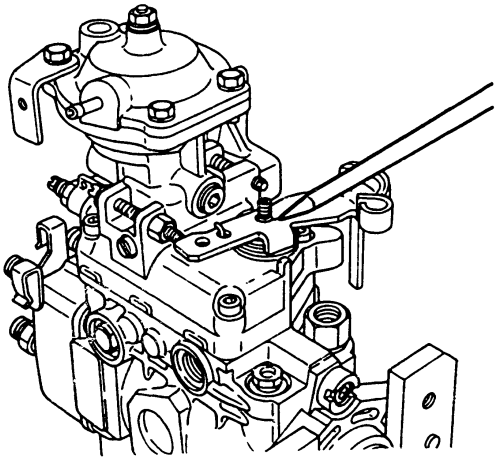


Fig. 8 Marking the control lever position

3. Mark the mounting position on the control lever (72) and the control shaft (68) to facilitate reassembly.

   Then remove the control lever.

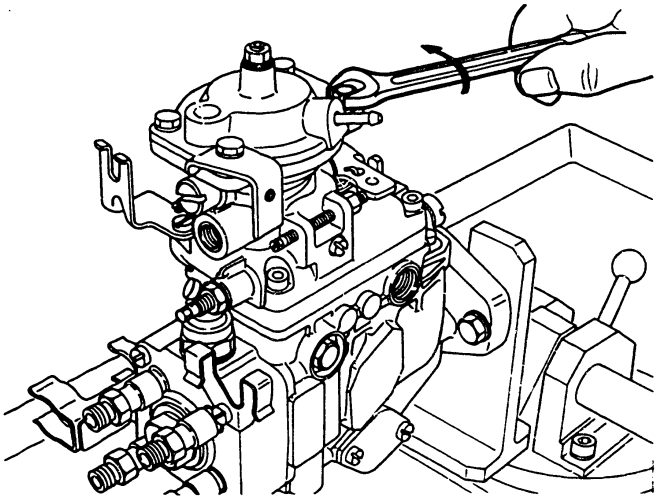


Fig. 9 Removing the cover bolts

4. Remove the four bolts (67/55) to remove the cover.

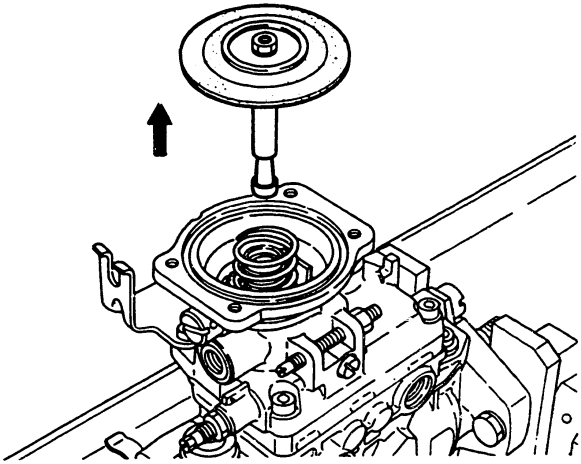


Fig. 10 Removing the diaphragm assembly

5. Remove the diaphragm assembly (67/42).

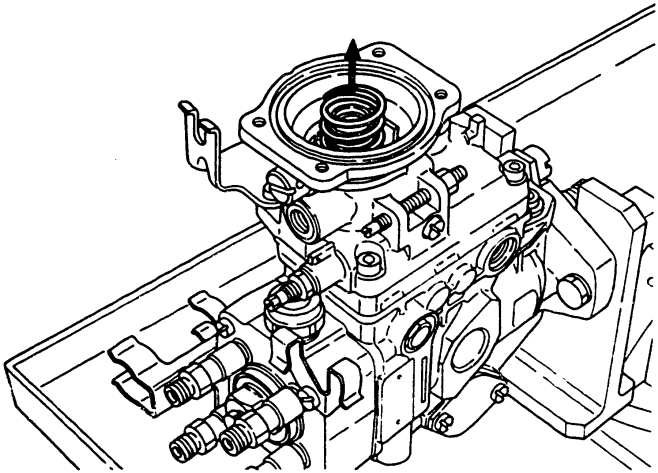


Fig. 11 Removing the boost compensator spring

6. Remove the boost compensator spring (67/47).

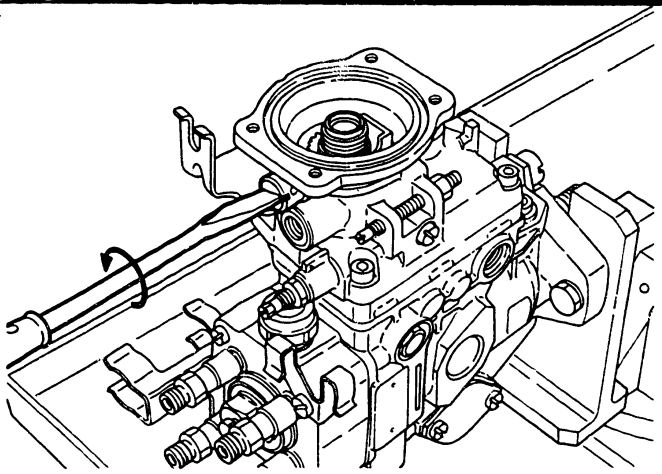


Fig. 12 Removing the air breather

7. Remove the air breather (67/60) to remove the ratchet nut (67/46).

Note: The ratchet nut can be turned easily if the lock plate (67/32) under the locknut (67/33) is expanded.

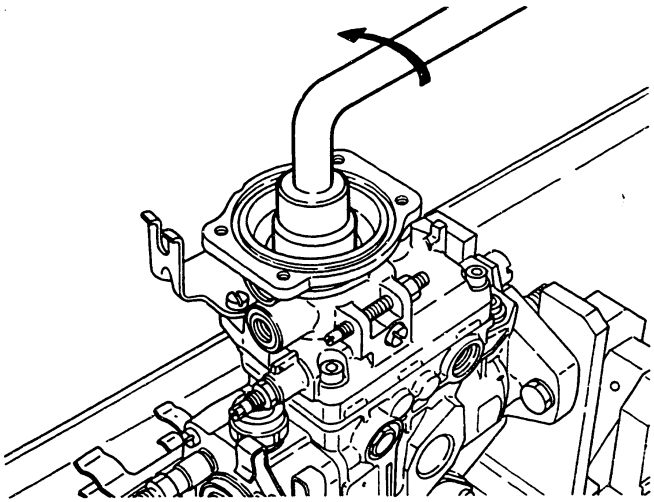


Fig. 13 Removing the locknut

8. Remove the locknut (67/33) using a socket wrench (SW24) and handle.

   Then, remove the lock plate.

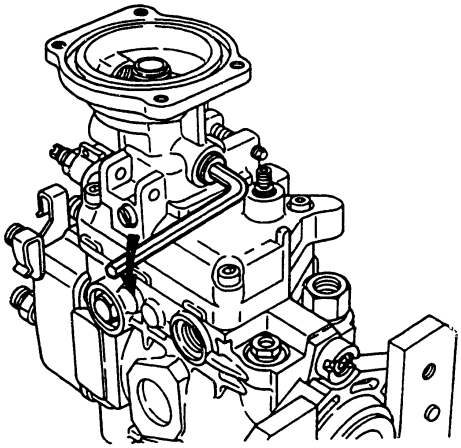


Fig. 14 Removing the plug

9. Remove the plug (67/39) and gasket (67/40) using a hexagon wrench (SW 6 mm).

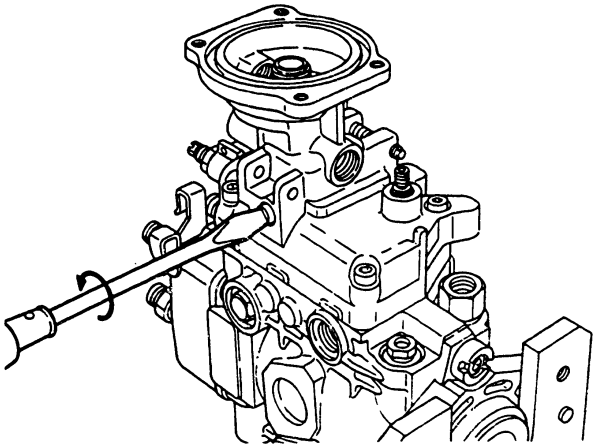


Fig. 15 Removing the screws

10. Remove the screws (67/58) and gaskets (67/59).

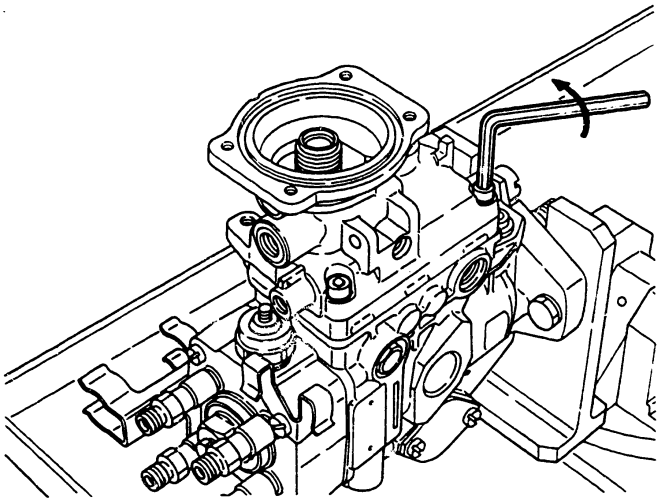


Fig. 16 Removing the bolts

11. Remove the four socket head bolts (123) fixing the governor cover using a hexagon wrench.

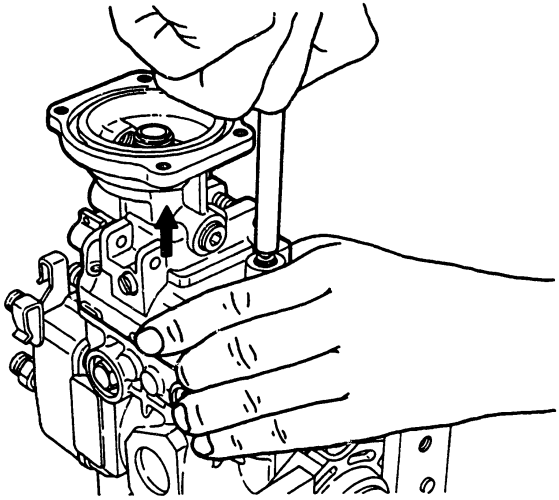


Fig. 17 Removing the governor cover

12. Remove the governor cover (67) from the injection pump by holding the control shaft with the inserter (KDEP 1096) and lifting the governor cover, after removing the full-load adjusting screw.

Note: Do not tap the control shaft using a hammer.

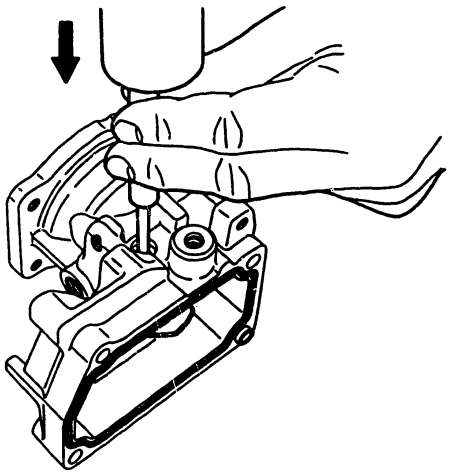


Fig. 18 Removing the lever pin

13. Extract the boost compensator lever pin (67/57) using the extractor (KDEP 2615) and a plastic mallet by tapping it from the right-hand side (viewed from the drive-side).

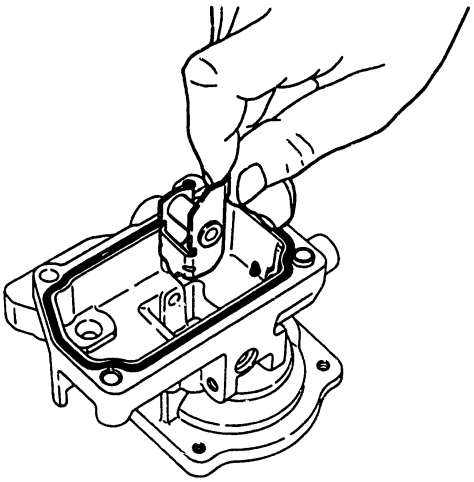


Fig. 19 Removing the lever

14. Remove the boost compensator lever.

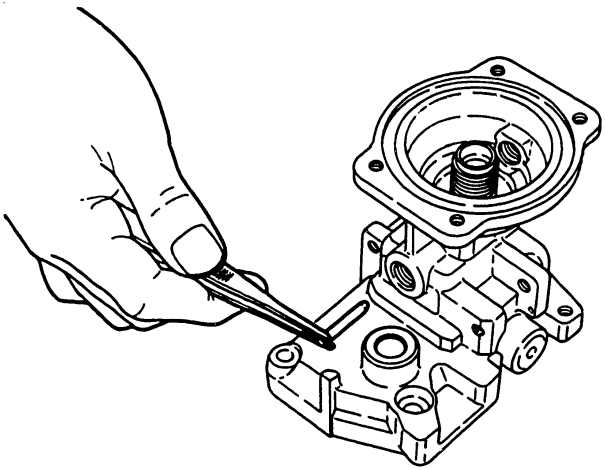


Fig. 20 Extracting the pin

15. Extract the pin (67/34) using tweezers.

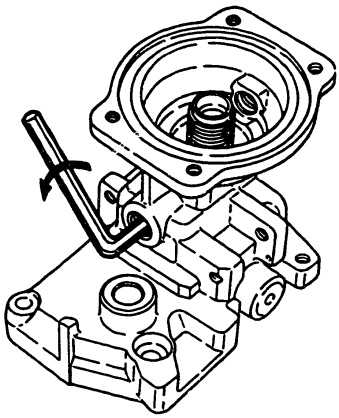


Fig. 21 Removing the nut

16. Remove the nut (67/35) using a hexagon wrench.

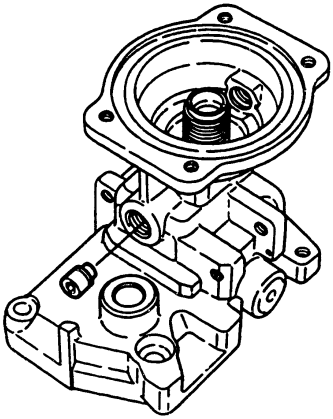


Fig. 22 Removing the bushing

17. Remove the bushing (67/37) together with the O-ring (67/36) and the gasket (67/38).

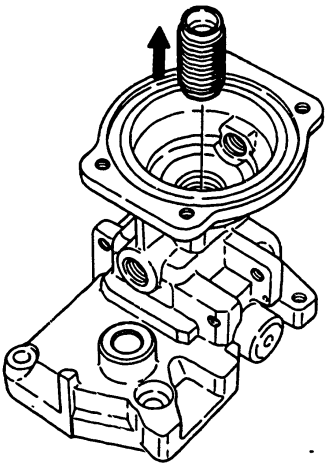


Fig. 23 Removing the screw bushing

18. Remove the screw bushing (67/31) from the governor cover.

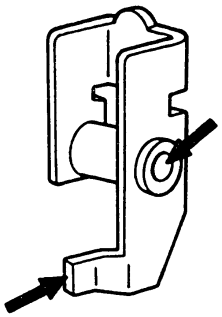


Fig. 24 Boost compensator lever

Inspection

1. Inspect the governor cover for cracks, wear and damage to the threaded portions.
   Replace the governor cover if defective.

2. Check that the boost compensator lever is not bent, that its surfaces contacting the pin and the governor lever are not worn excessively and that it moves smoothly and firmly on the lever pin.
   Replace the boost compensator lever (and the lever pin) if defective. (Fig. 24)

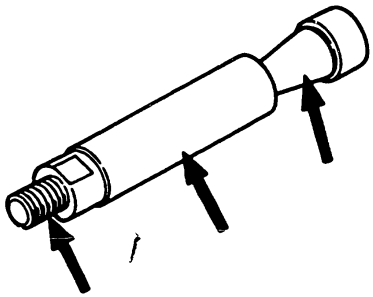


Fig. 25 Adjusting pin

3. Check that the adjusting pin's tapered portion is not worn or scratched excessively, that the adjusting pin's sliding surface is not worn, scratched or damaged excessively and that the adjusting pin's threaded portion is not damaged.
   Replace the adjusting pin if defective.(Fig. 25)

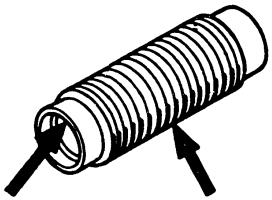


Fig. 26 Screw bushing

4. Check that the screw bushing's threaded portion is not damaged or worn excessively and that the adjusting pin moves smoothly and firmly in the screw bushing.
   Replace the screw bushing (and the adjusting pin) if defective.(Fig. 26)

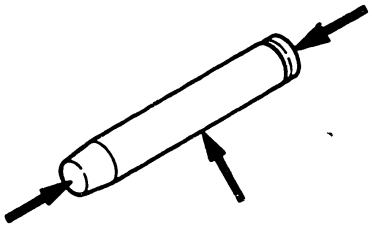


Fig. 27 Pin

5. Check that the pin's surface and both tips are not worn, scratched or damaged excessively. Replace the pin if defective. (Fig. 27)

6. Check that the boost compensator spring is not rusted, scratched, bent or unevenly worn. Replace the spring if defective.

7. Inspect the other parts carefully. If they are damaged, worn, rusted or bent excessively they must be replaced.

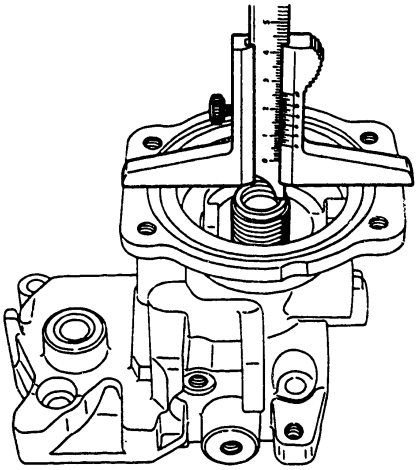


Fig. 28 Installing the screw bushing

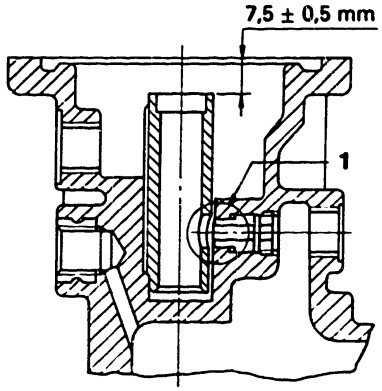


Fig. 29 Screw bushing installation position

1 = Screw bushing/
governor cover hole

Reassembly

1. Install the screw bushing (67/31) so that the distance between the tip of the screw bushing and the face of the governor cover is 7.5 ± 0.5 mm.

   Ensure that the screw bushing hole is aligned with the governor cover hole shown in Figs. 28 and 29.

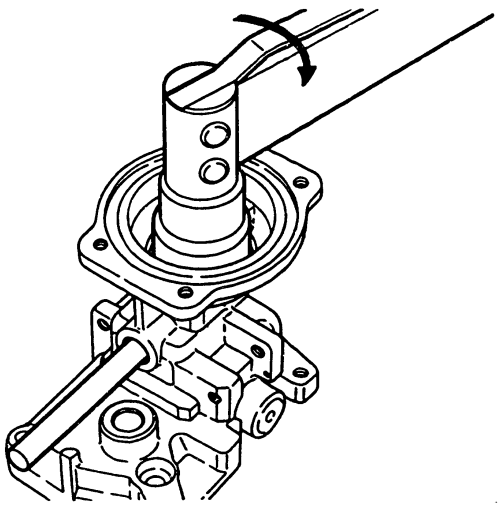


Fig. 30 Tightening the locknut

2. Tighten the locknut (67/33) to fix the screw bushing (67/31) and the lock plate (67/32) to the specified torque, while using the special tool (KDEP 2617) to ensure that the screw bushing does not move from the above position. (Fig. 30).

   Specified tightening torque: 2.5 to 3.5 kg.m

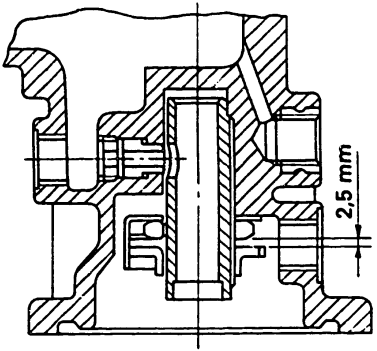


Fig. 31 Ratchet nut installation position

3. Screw the ratchet nut (67/46) onto the screw bushing (67/31) so that the distance between the locknut' s (67/33) end face and the ratchet nut' s bottom face is approximately 2.5 mm.

   To do this, fully tighten the ratchet nut two and a half turns (as its pitch is 1 mm). (Fig. 31)

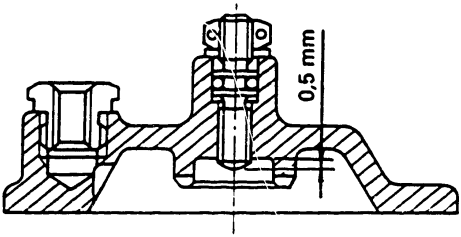


Fig. 32 Stopper bolt installation position

4. Install the stopper bolt (67/50), as described below, so that the distance between the tip of the stopper bolt and the inside face of the cover (67/49), in the case of the conventional type cover, is 0.5 mm.

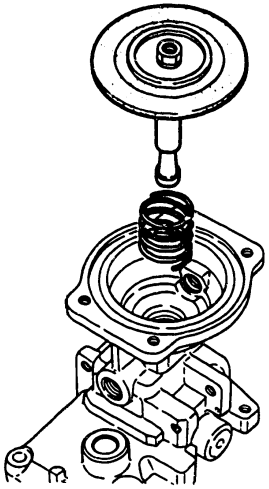


Fig. 33 Temporarily installing the diaphragm assembly

-1 Temporarily install the boost compensator spring (67/47) and the diaphragm assembly. (Fig. 33)

-2 Temporarily install the stopper bolt (67/50) and the locknut (67/53) to the cover (67/49).

Note: At this time, do not install the O-ring (67/51) or washer (67/52), so that the stopper bolt may be screwed in smoothly.

-3 Install the cover (67/49) to the governor cover.

-4 Screw in the stopper bolt (67/50) until it contacts the tip of the adjusting pin installed in the diaphragm.

Note: When tightening the stopper bolt, the position where the screwing resistance changes is the position where it contacts the adjusting pin.

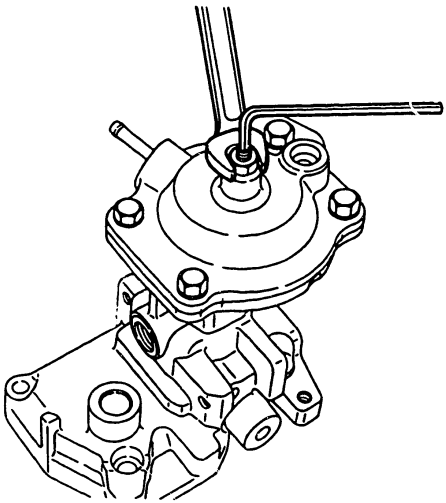


Fig. 34 Setting the stopper bolt position

-5 Then, screw the stopper bolt (67/50) a further half turn and fix it using the lock-nut (67/53). (Fig. 34)
The stopper bolt is now set in a position where it protrudes 0.5 mm from the cover's face.

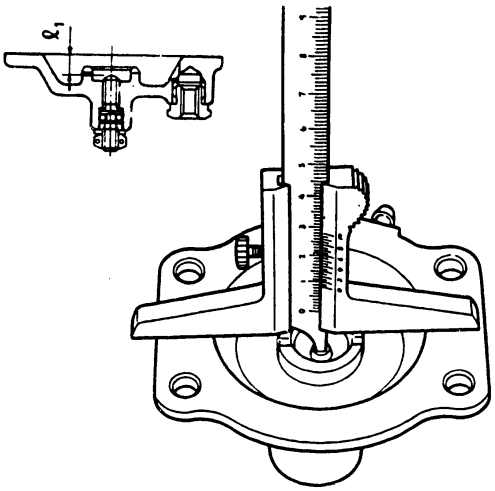


Fig. 35 Measuring the distance ℓ_1

-6 After removing the cover (67/49) from the governor cover , measure the distance (ℓ_1) between the tip of the stopper bolt and the inside face of the cover. (Fig. 35)

-7 Remove the stopper bolt and then reinstall it and the washer, after installing the O-ring (67/51) to the stopper bolt, so that the distance between the tip of the stopper bolt and the inside face of the cover is as measured above. Then fix it using the locknut (67/53).

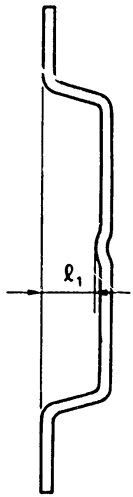


Fig. 36 Distance ℓ_1

5. Adjust the boost compensator stroke using a spacer (67/48).
   Calculate its thickness as described below.

-1 For the cost-reduction type cover, measure the distance ℓ_1 between the tip of the indentation in the cover (67/49) and the inside face of the cover.
   For the conventional type, use the measurement obtained in 4 — 6 above.

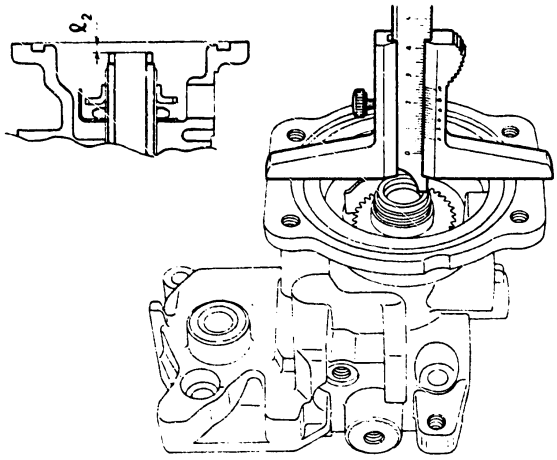


Fig. 37 Measuring the distance ℓ_2

-2 Measure the distance ℓ_2 between the tip of the screw bushing (67/31) and the face of the governor cover.

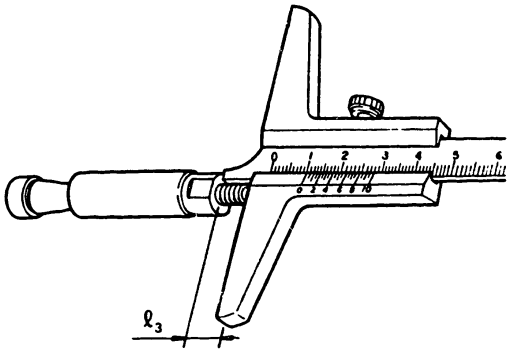


Fig. 38 Measuring the distance ℓ_3

-3 Measure the length ℓ_3 of the adjusting pin's threaded portion. (Fig. 38)

-4 After measuring the above dimensions calculate the thickness of the spacer (67/48) using the following formula.

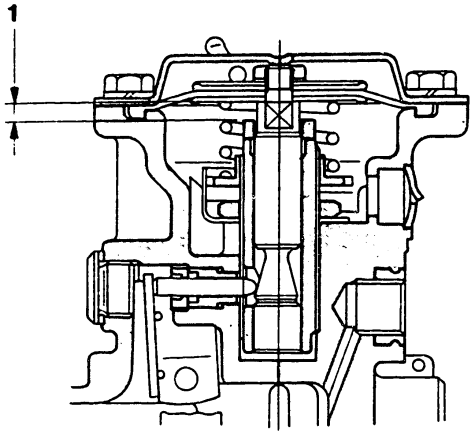


Fig. 39 Boost compensator stroke

1 = Boost compensator stroke

Boost compensator stroke
$= \ell_1 + \ell_2 - \ell_3$ — Spacer thickness

Therefore,
Spacer thickness $= \ell_1 + \ell_2 - \ell_3$ — Boost compensator stroke

If the spacer thickness calculated from the above formula differs from the thickness of the spacer previously installed, replace the spacer so that the boost compensator stroke is as specified.

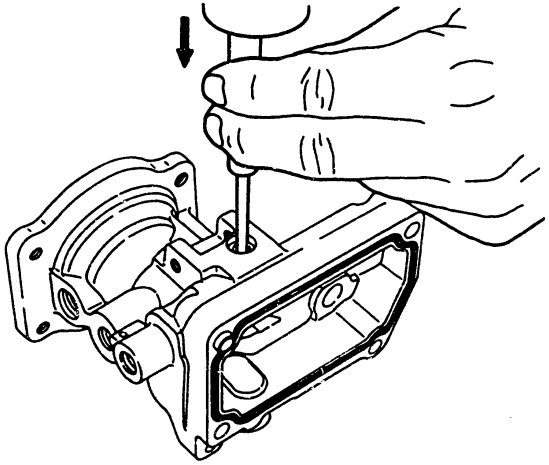


Fig. 40 Pressfitting the pin

6. Pressfit the boost compensator lever pin (67/57), using the extractor (KDEP 2615) and a plastic mallet, from the left-hand side (viewed from the drive side) to install the boost compensator lever (67) in the governor cover.

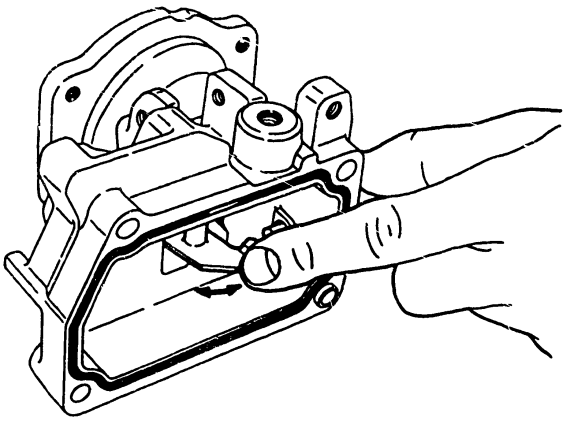


Fig. 41 Checking lever movement

7. Ensure that the boost compensator lever moves smoothly.

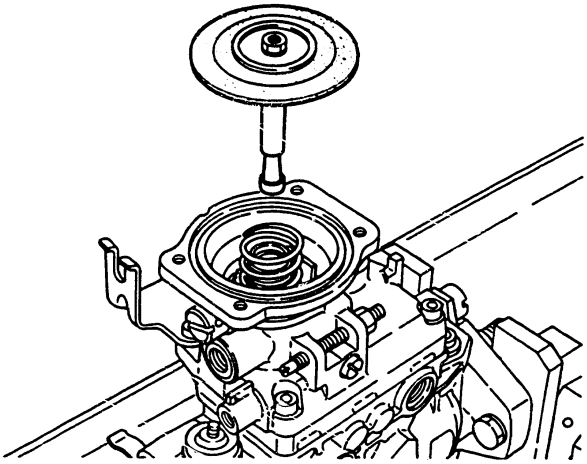


Fig. 42 Installing the boost compensator parts

8. Adjust the boost compensator lever position as described below.

-1 Install all internal boost compensator parts.

Note: The diaphragm must be replaced with a new one.

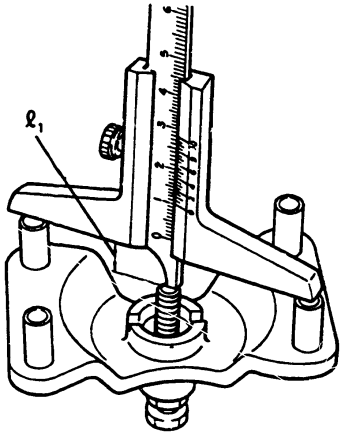


Fig. 43 Adjusting the stopper bolt position

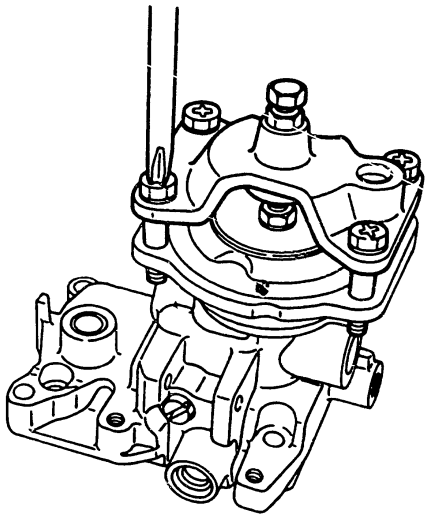


Fig. 44 Installing the cover

-2 Install the adjusting cover (KDEP 2616) to the boost compensator after adjusting the cover's stopper bolt installation position so that the distance between the tip of the stopper bolt and the face of the cover is ℓ_1, as measured in 4 - 6 or 5 - 1 above. (Fig. 43)

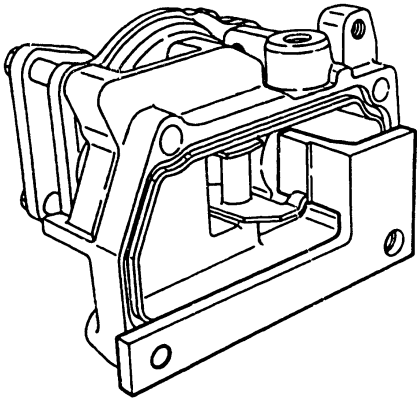


Fig. 45 Attaching the block gauge

-3 Securely attach the block gauge (KDEP 1152) to the boost compensator as shown in fig. 45.

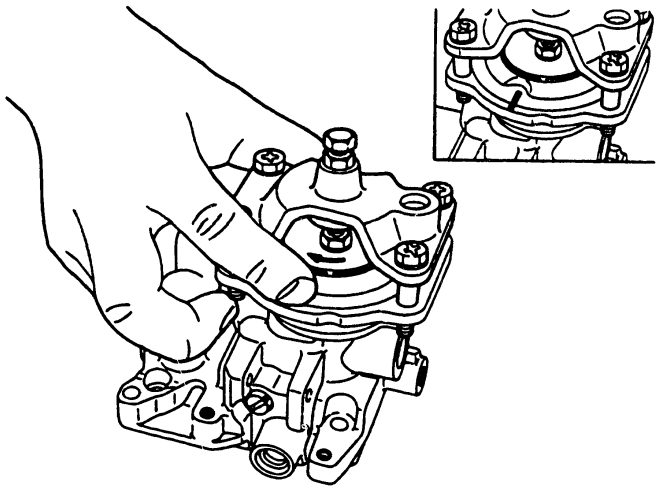


Fig. 46 Rotating the diaphragm assembly

-4 Rotate the diaphragm assembly by hand until increased resistance to rotation is felt.

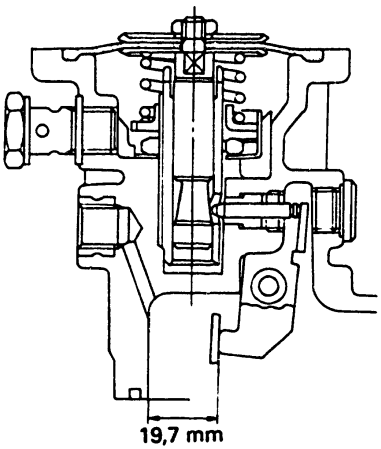


Fig. 47 Boost compensator lever position

-5 Then, ensure that the tip of the boost compensator lever flange contacts the block gauge.

The boost compensator lever should now be in a position where the distance between the tip of the boost compensator lever flange and the inside face of the governor cover is 19.7 mm. (Fig. 47)

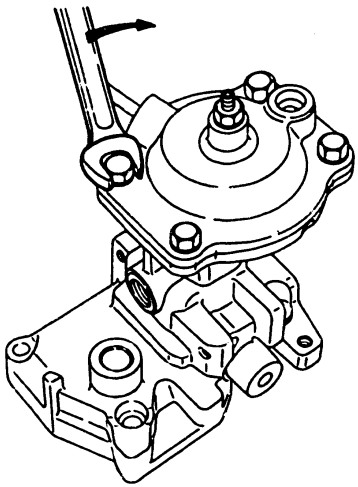


Fig. 48 Installing the cover

10. After removing the adjusting cover and the block gauge, install the cover to fix the diaphragm assembly while ensuring that the diaphragm assembly does not move.

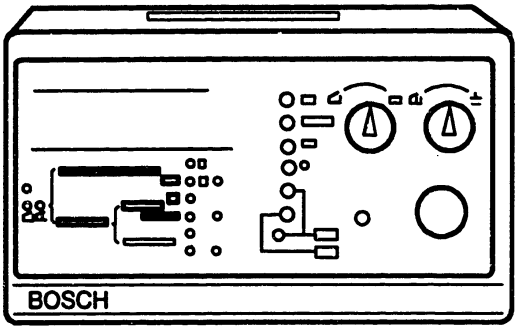


Fig. 49 Special tool for adjustment

Part No.	Part Name	Remarks
0 684 200 610	Pressure control kit	For adjusting boost compensator

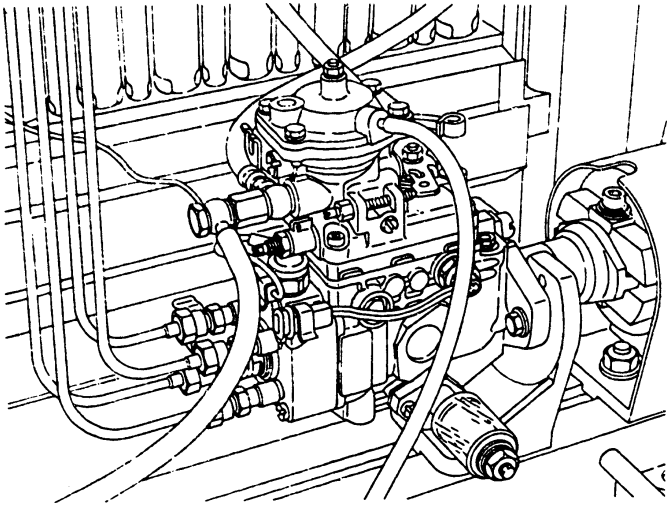


Fig. 50 Connecting the air pipes

Adjustment

1. Connect the air pipes to the injection pump using the pressure control kit (0 684 200 610) as shown in Fig. 50.

Note: The pressure control kit is necessary as a compressed air source.

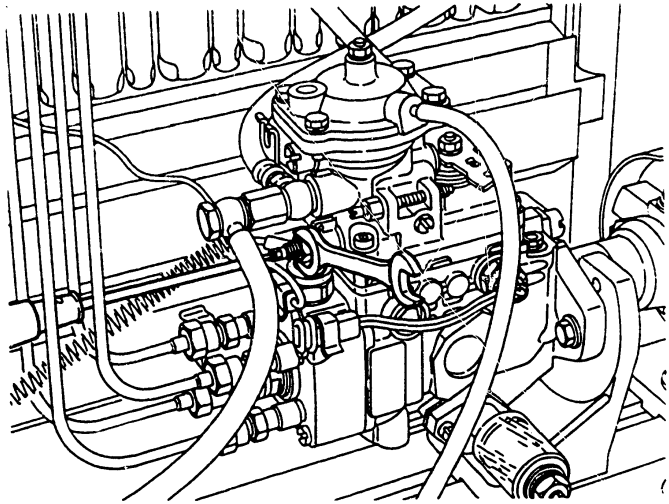


Fig. 51 Adjusting the full-load injection quantity

2. After setting the control lever at the maximum-speed position, adjust the full-load injection quantity using the full-load adjusting screw while the boost pressure is 0 mmHg. (Fig. 51)

Note: This procedure is the same as that for conventional adjustment (i.e. without a boost compensator).

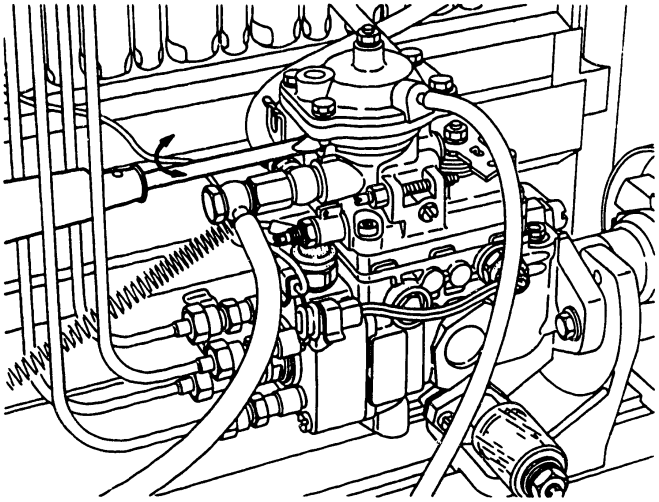
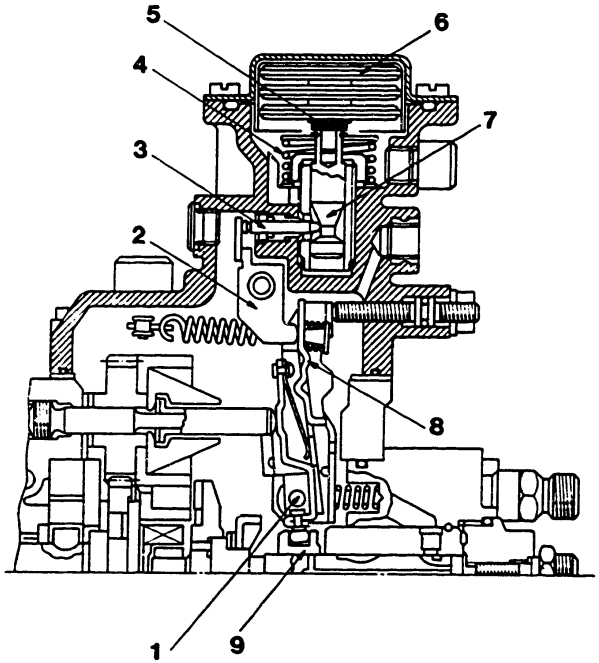


Fig. 52 Readjusting the full-load quantity

3. Readjust the full-load injection quantity by adjusting the ratchet nut position while supplying the boost pressure specified in the calibration data.



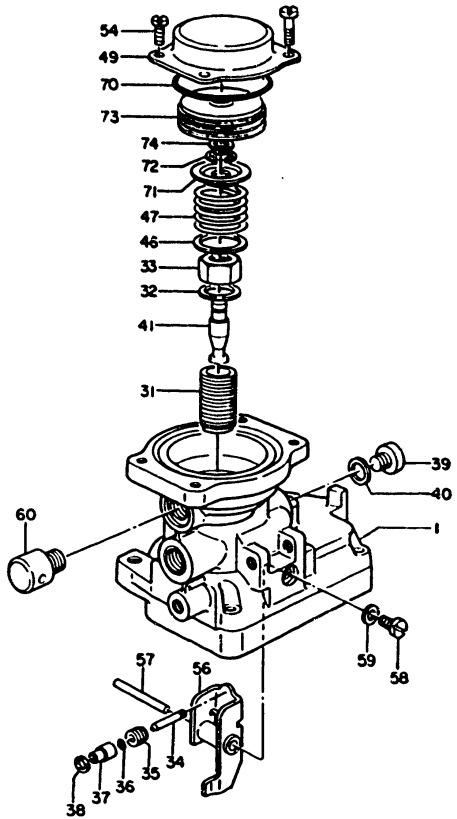


Fig. 53 Aneroid compensator - exploded view

ANEROID COMPENSATOR

1 = Pivot B
2 = Lever
3 = Pin
4 = Spring
5 = Shim
6 = Bellows
7 = Adjusting pin
8 = Tension lever
9 = Control sleeve

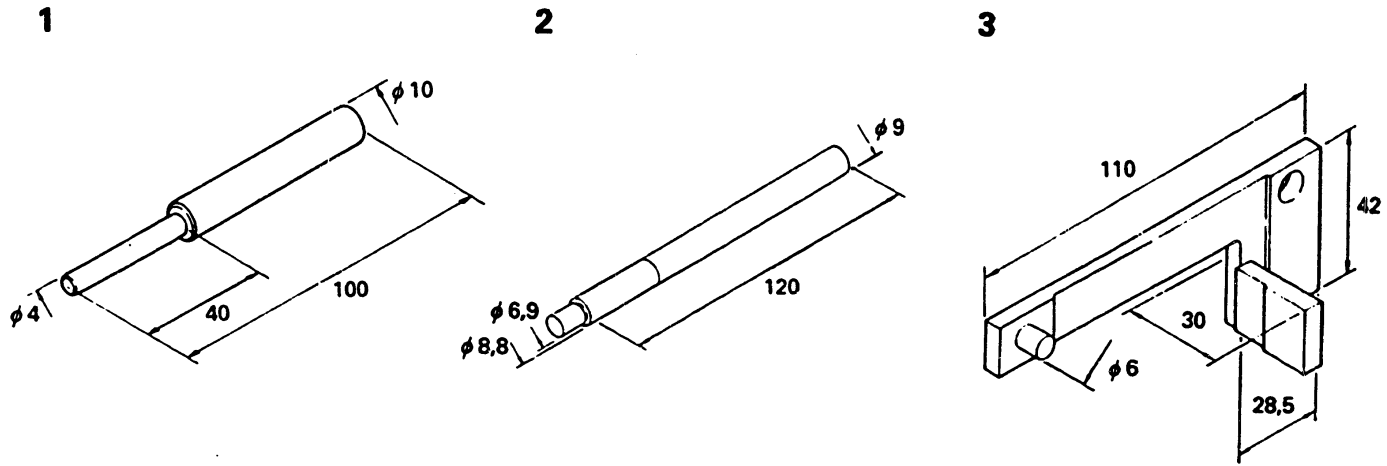


Fig. 54 Special Tools for Disassembly and Reassembly

1 = Extractor 2 = Guide pin 3 = Block gauge

No.	Part No.	Part Name	Q' ty	Remarks
1	KDEP 2615	Extractor	1	For extracting aneroid compensator lever pin
2	KDEP 2617	Guide pin	1	For holding screw bushing
3	KDEP 1152	Block gauge	1	For adjusting aneroid compensator lever position

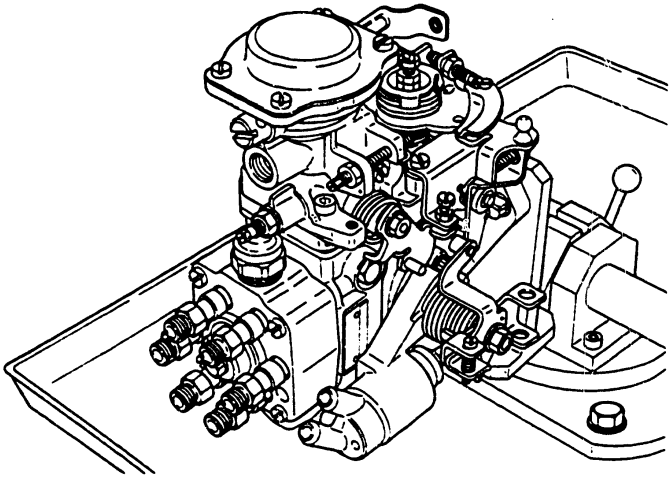


Fig. 55 Attaching the injection pump to the brackets

Disassembly

1. Attach the injection pump to the bracket (KDEP 2963) using the bolts. (Fig. 55)

2. Remove the external attachments (fuel pipes, brackets etc.) to facilitate disassembly of the aneroid compensator from the injection pump.

3. Remove the nut (75) fixing the control lever (72) and the spring washer (73).

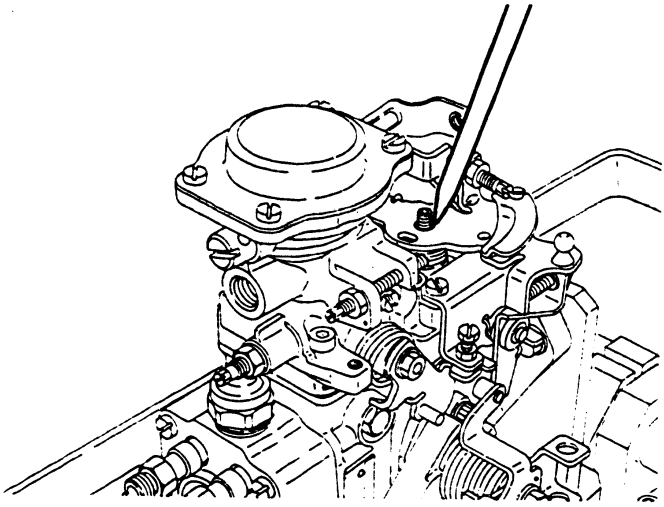


Fig. 56 Marking the control lever position

4. Mark the mounting position on the control lever (72) and the control shaft (68) to facilitate reassembly. Then, remove the control lever.

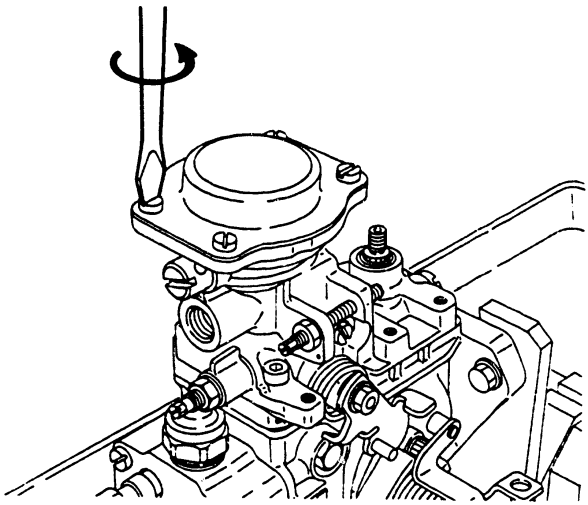


Fig. 57 Removing the cover screws

5. Remove the four screws (67/54) to remove the cover (67/49).

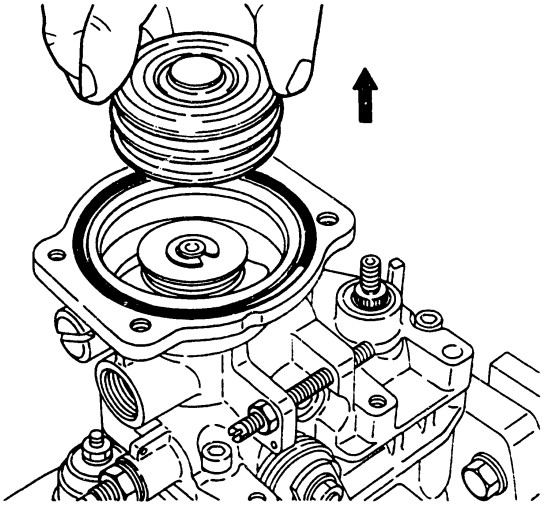


Fig. 58 Removing the bellows

6. Remove the bellows (67/73) together with the shim (67/74).

Note: Take care not to lose the shim (67/74).

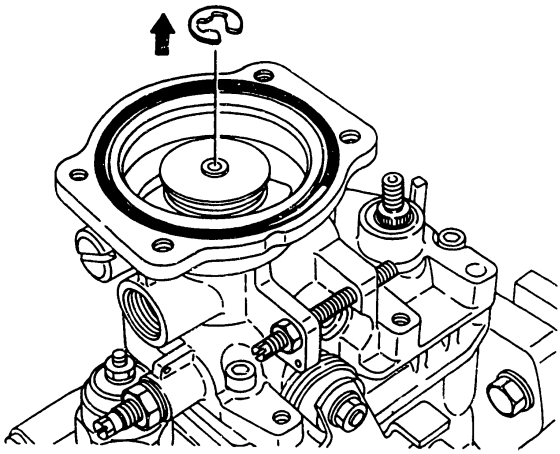


Fig. 59 Removing the snapring

7. Remove the snapring (67/72) fixing the spring seat (67/71) while holding the spring seat down.

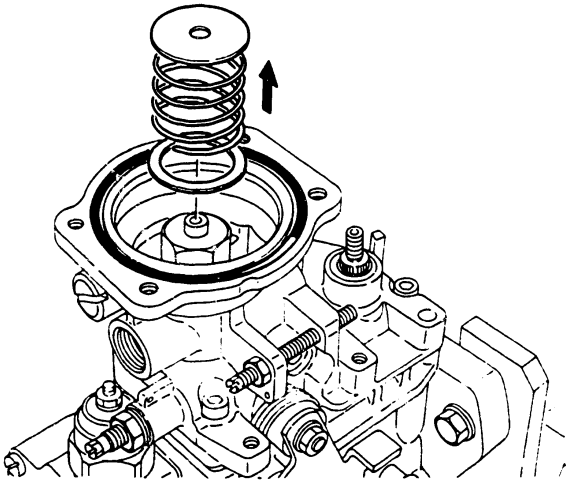


Fig. 60 Removing the aneroid compensator spring

8. Remove the spring seat (67/71), aneroid compensator spring (67/47) and washer (67/46).

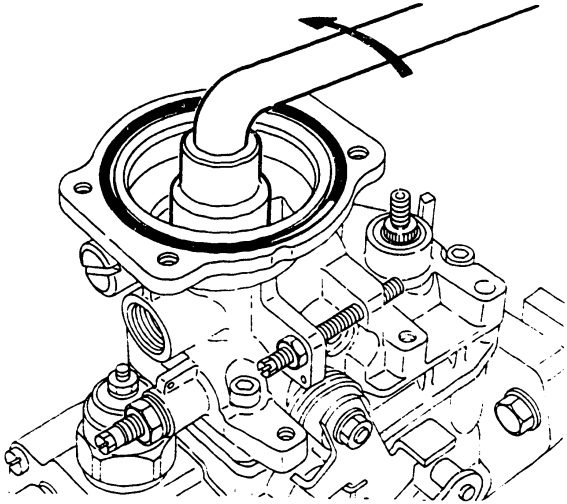


Fig. 61 Removing the locknut

9. Remove the locknut (67/33) together with the washer (67/32) using a socket wrench (SW24) and handle. (Fig. 61)

Note: The wrench's outside diameter must be less than 31 mm to prevent interference with the governor cover.

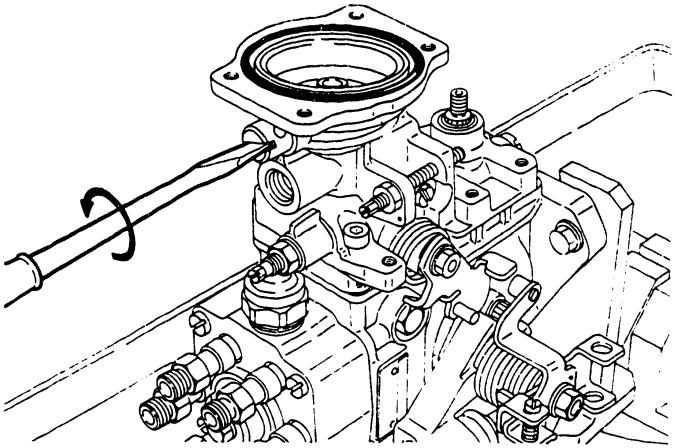


Fig. 62 Removing the air breather

10. Remove the air breather (67/60).

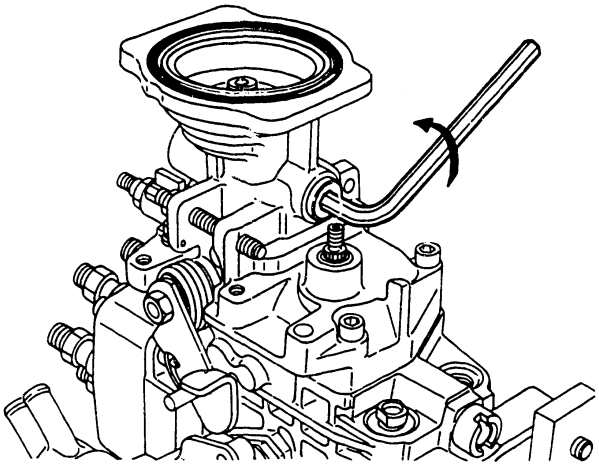


Fig. 63 Removing the plug

11. Remove the plug (67/39) and gasket (67/40) using a hexagon wrench.

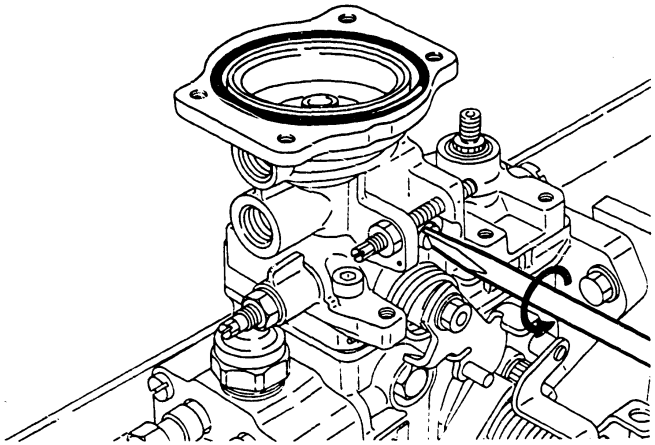


Fig. 64 Removing the screws

12. Remove the screws (67/58) and gaskets (67/59).

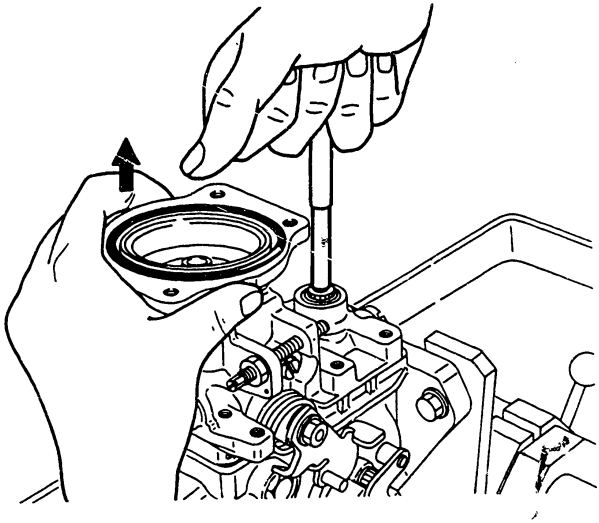


Fig. 65 Removing the governor cover

13. Remove the four socket head bolts (123) fixing the governor cover using a hexagon wrench.

14. Remove the governor cover (67/1) from the injection pump, after removing the full-load adjusting screw (88), by holding the control shaft (68) with the inserter (KDEP 1096) and lifting the governor cover. (Fig. 65)

Note: Do not tap the control shaft using a hammer.

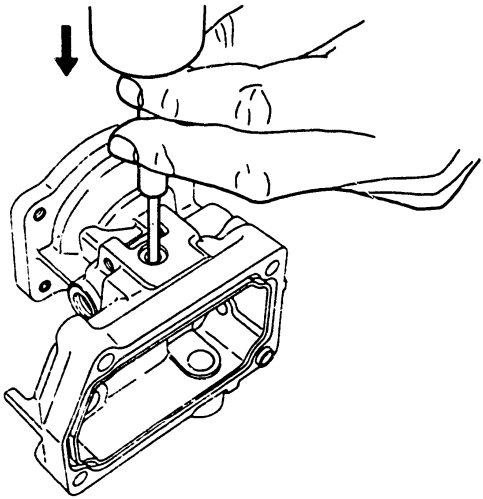


Fig. 66 Removing the lever pin

15. Extract the aneroid compensator lever pin (67/57), using the extractor (KDEP 2615) and a plastic mallet, by tapping it from the right-hand side (viewed from the drive side). (Fig. 66)

16. Remove the aneroid compensator lever (67/56).

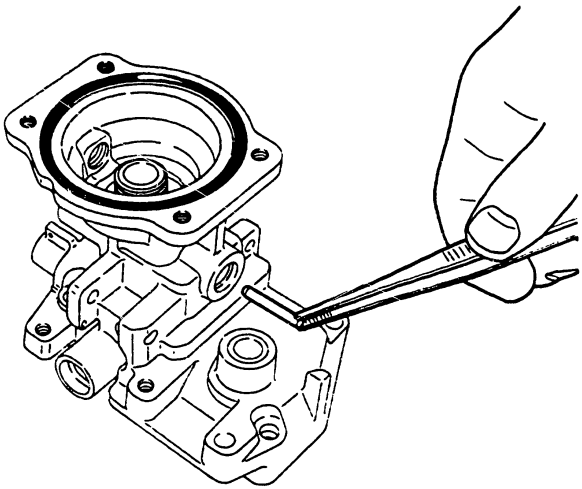


Fig. 67 Extracting the pin

17. Extract the pin (67/34) using tweezers.

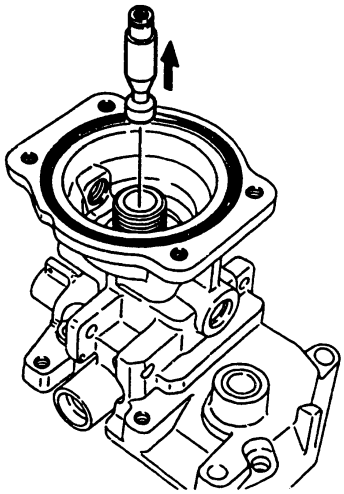


Fig. 68 Removing the adjusting pin

18. Remove the adjusting pin (67/41) from the screw bushing (67/37).

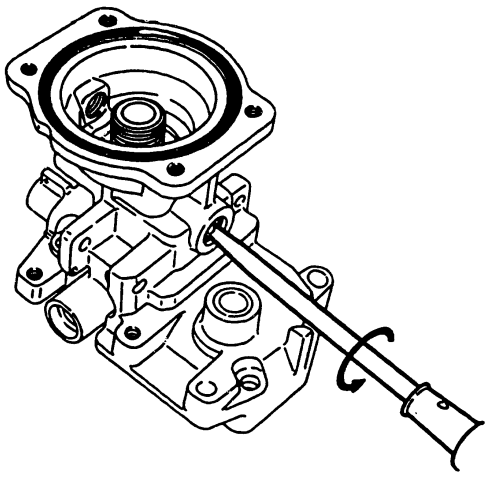


Fig. 69 Removing the screw

19. Remove the screw (67/35) fixing the bushing (67/37). (Fig. 69)

20. Remove the bushing (67/37) together with the O-ring (67/36) and the gasket (67/38).

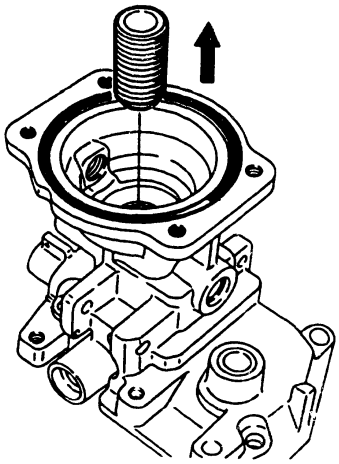


Fig. 70 Removing the screw bushing

21. Remove the screw bushing (67/31) from the governor cover.

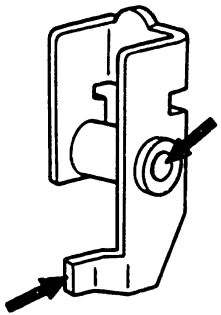


Fig. 71 Aneroid compensator lever

Inspection

1. Inspect the governor cover for cracks, wear and damage to the threaded portions.
   Replace the governor cover if defective.

2. Check that the aneroid compensator lever is not bent, that its surfaces contacting the pin and the governor lever are not worn excessively and that it moves smoothly and firmly on the lever pin.
   Replace the aneroid compensator lever (and the lever pin) if defective. **(Fig. 71)**

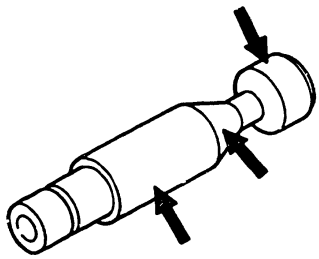


Fig. 72 Adjusting pin

3. Check that the adjusting pin's tapered portion is not worn or scratched excessively and that the adjusting pin's sliding surface is not worn, scratched or damaged excessively.

   Replace the adjusting pin if defective. (Fig. 72)

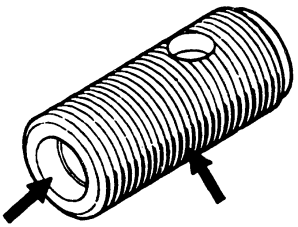


Fig. 73 Screw bushing

4. Check that the screw bushing's threaded portion is not damaged or worn excessively and that the adjusting pin moves smoothly and firmly in the screw bushing.
   Replace the screw bushing (and the adjusting pin) if defective. **(Fig. 73)**

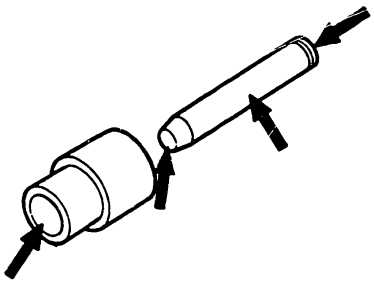


Fig. 74 Pin

5. Check that the pin's surface and both tips are not worn, scratched or damaged excessively. Replace the pin if defective. (Fig. 74)

6. Check that the aneroid compensator spring is not rusted, scratched, bent or unevenly worn. Replace the spring if defective.

7. Inspect other parts carefully. If they are damaged, worn, rusted or bent excessively they must be replaced.

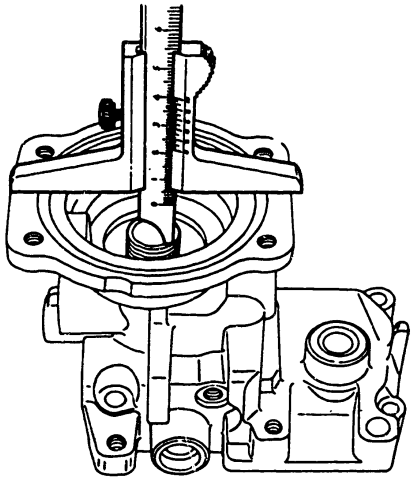


Fig. 75 Installing the screw bushing

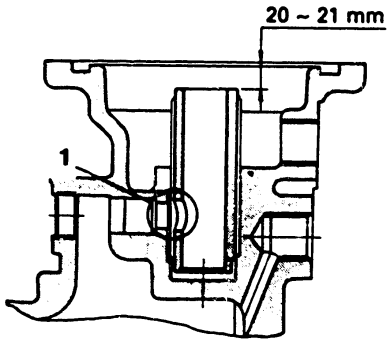


Fig. 76 Screw bushing installation position

1 = Screw bushing/
governor cover hole

Reassembly

1. Install the screw bushing (67/31) so that the distance between the tip of the screw bushing and the face of the governor cover is 20.0 to 21.0 mm.

   Ensure that the screw bushing hole is aligned with the governor cover hole shown in Figs. 75 and 76.

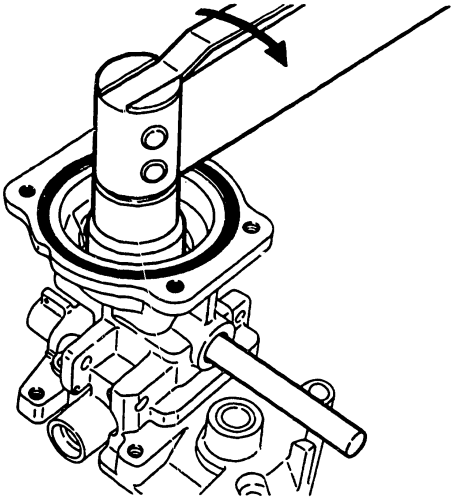


Fig. 77 Tightening the locknut

2. Install the locknut (67/33) and washer (67/32) and then tighten the locknut to fix the screw bushing (67/31) to the specified torque, while using the special tool (KDEP 2617) to ensure that the screw bushing does not move from the above position. (Fig. 77)

   Specified tightening torque: 2.5 to 3.5 kg.m

   Then, install the adjusting pin, washer (67/46), spring (67/47) and spring seat (67/71) and fit the snapring (67/74) in the adjusting pin groove.

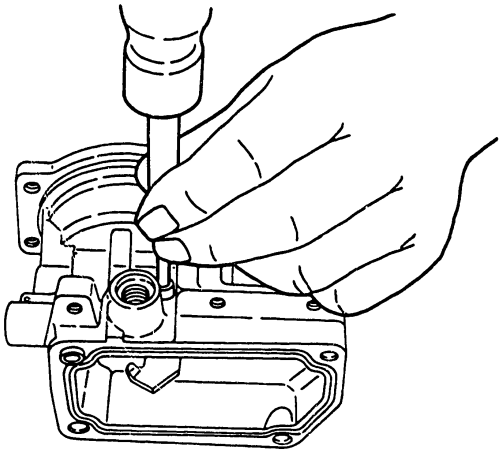


Fig. 78 Installing the pin

3. Pressfit the aneroid compensator lever pin (67/57), using the extractor (KDEP 2615) and a plastic mallet, from the left-hand side (viewed from the drive-side) to install the aneroid compensator lever (67/56) in the governor housing. (Fig. 78)

4. Ensure that the aneroid compensator lever moves smoothly.

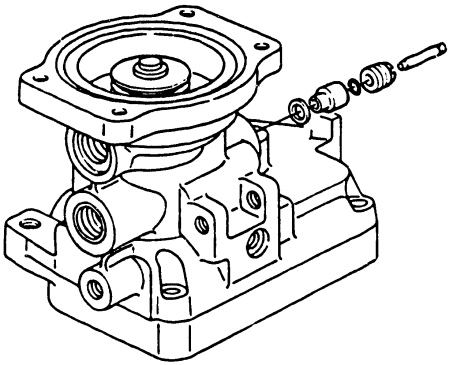


Fig. 79 Installing the bushing and related parts

5. Install the gasket (67/38) and the bushing (67/37) together with the O-ring (67/36) to the governor cover (67/1), and then install and tighten the screw (67/35) fixing the bushing (67/37) to the specified torque.

   Tightening torque: 0.9 ~ 1.2 kgm

6. Install the pin (67/34) to the bushing.

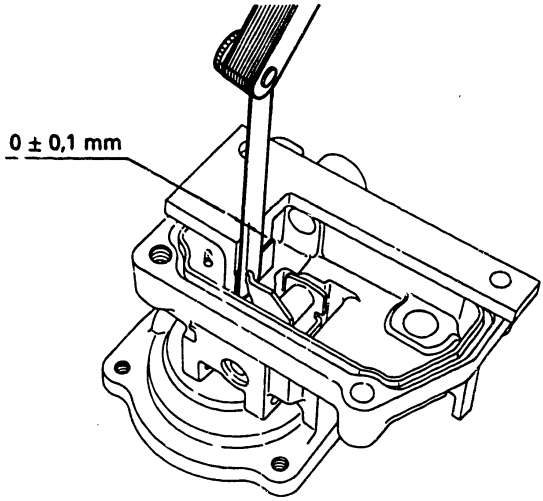


Fig. 80 Confirming the aneroid compensator lever position

7. After securely attaching the block gauge **(KDEP 1152)** to the aneroid compensator, confirm using a thickness gauge that the aneroid compensator lever is in the specified position, where the distance between the top of the aneroid compensator lever flange and the block gauge is $0 \pm^{0.1}$ mm.
   If not within the specified range, adjust it by replacing the pin (67/34).

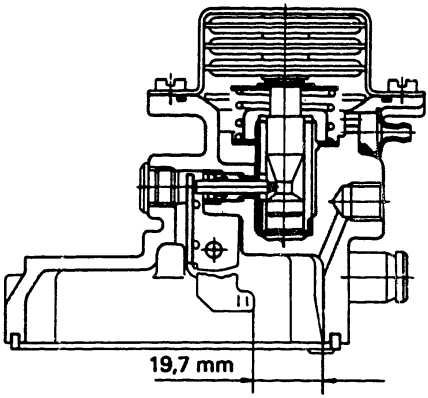
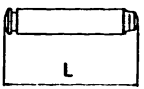


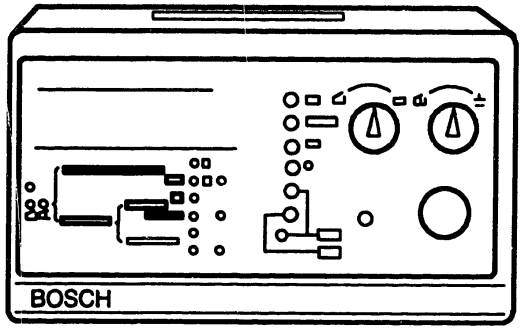
Fig. 81 Aneroid compensator lever position

The aneroid compensator lever should now be in a position where the distance between the tip of the aneroid compensator lever flange and the inside face of the governor cover is 19.7mm.

Part No. *	Length (mm)	Shape
146712-0200	24.6	
146712-0300	24.8	
146712-0400	25.0	
146712-0500	25.2	
146712-0600	25.4	

*) Bosch No., see cross reference DKKC - Bosch, microfiche HB 30, HB 31.

1



2

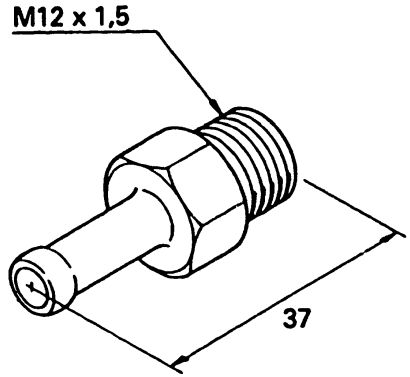


Fig. 82 Special tools for aneroid compensator adjustment

1 = Pressure control kit

2 = Union

Special Tools for Adjustment

No.	Part No.	Part Name	Q' ty	Remarks
1	0 684 200 610	Pressure control kit	1	For adjusting aneroid compensator
2	commerc. available	Union	1	For air piping

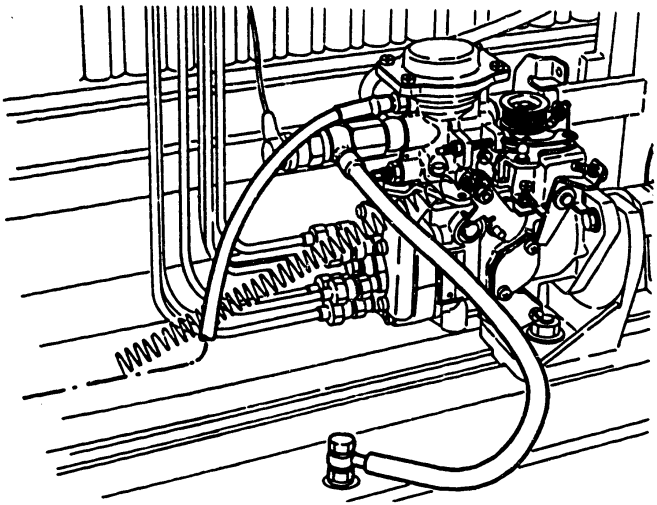


Fig. 83 Connecting the air pipes

Adjustment

1. After replacing the air breather with a hose joint, connect the air pipes to the injection pump using the pressure control kit (0 684 200 610) and the union (commerc. avialable).

Note: The pressure control kit is necessary as a compressed air source.

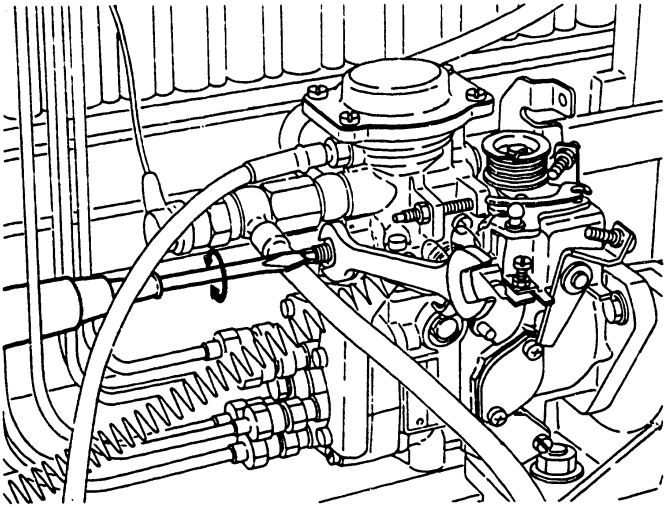


Fig. 84 Adjusting the full-load injection quantity

2. After setting the control lever at the maximum-speed position, adjust the full-load injection quantity using the full-load adjusting screw while the negative pressure is 0 mm Hg.

Note: This procedure is the same as that for conventional adjustment (i.e. without an aneroid compensator). (Fig. 84)

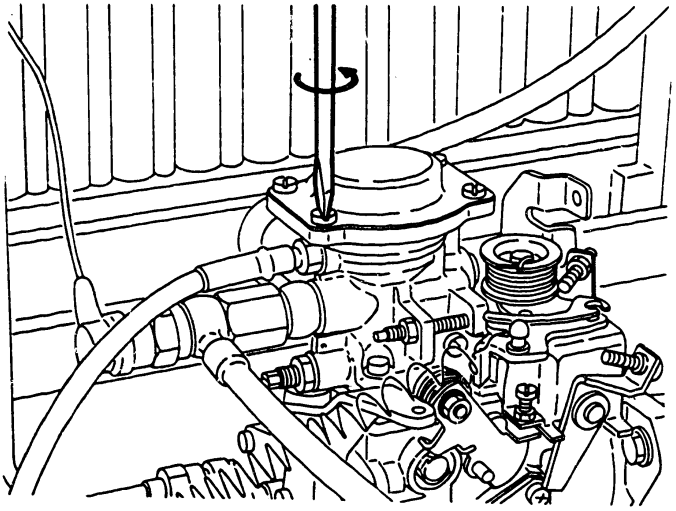


Fig. 85 Removing the cover

3. Readjust the full-load injection quantity as described below.
-1 Measure the full-load injection quantity while suppling the negative pressure specified in the calibration data.
-2 If the full-load injection quantity is not as specified, adjust it by replacing the shim (67/74) under the bellows (67/73).

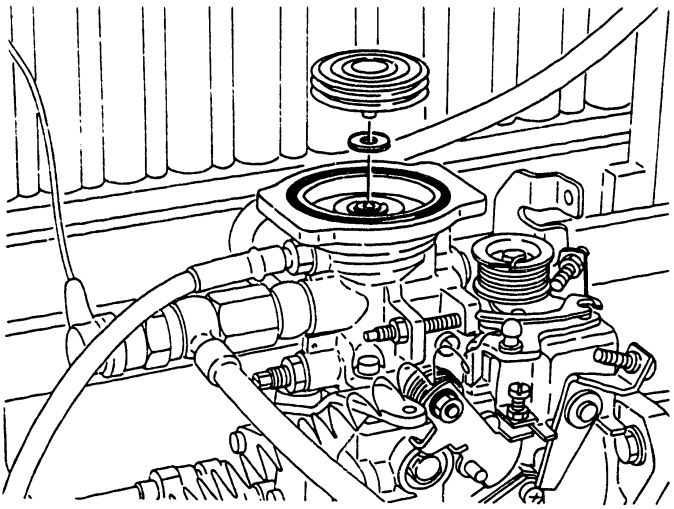
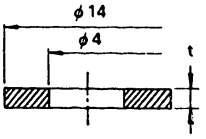


Fig. 86 Replacing the shim

1. All other adjustments, except for the aneroid compensator adjustment (i.e. item 3 above), should be performed after removing the bellows cover.

2. Aneroid compensator adjustment should be performed using the "aneroid compensator characteristics" graph in the calibration data (which varies from the standard calibration data) that indicates the relationship between altitude (or atmospheric pressure) and injection quantities.

Part No. *	t	Shape
146603-3700	0.2	
146603-3800	0.3	
146603-3900	0.5	
146603-4000	0.7	
146603-4100	1.0	
146603-4200	1.5	

Unit: mm

* Bosch No., see cross reference DKKC - Bosch, microfiche HB 30, HB 31.

Note: Refer to the following procedures when performing the injection pump adjustments at high altitudes as the standard calibration data is applicable only to sea level.

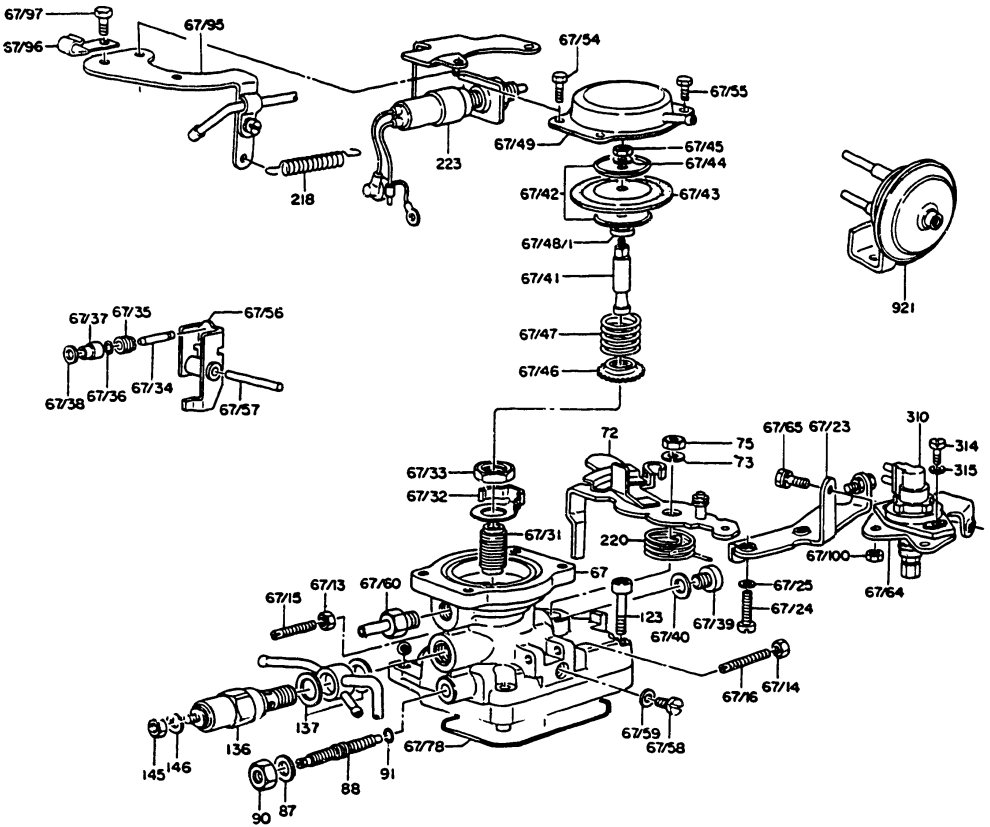


Fig. 87 A.B.C.S. - exploded view

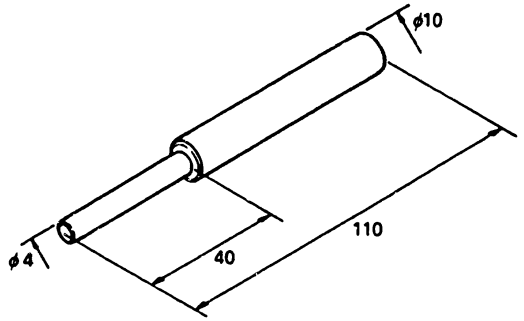
ANEROID/BOOST COMPENSATOR (A.B.C.S.)

Figure 87 shows an exploded view of the A.B.C.S.

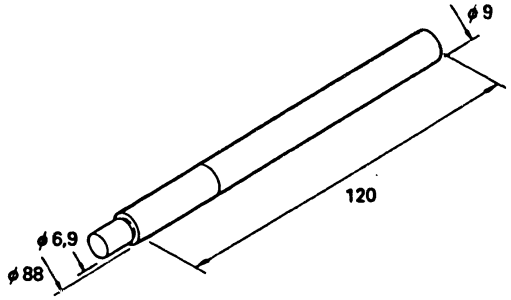
Special Tools for Disassembly and Reassembly

No.	Part No.	Part Name	Q' ty	Remarks
1	KDEP 2615	Extractor	1	For extracting A.B.C.S. lever pin
2	KDEP 2617	Guide pin	1	For holding screw bushing
3	KDEP 1152	Block gauge	1	For adjusting A.B.C.S. lever position
4	KDEP 2616	Adjusting cover	1	For adjusting diaphagm assembly position

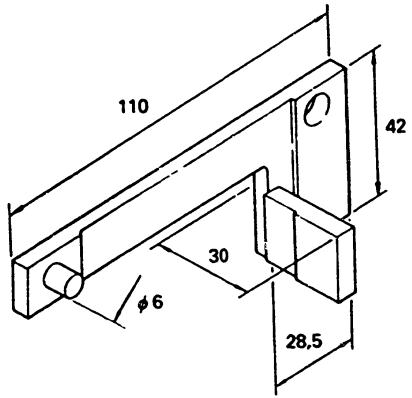
1



2



3



4

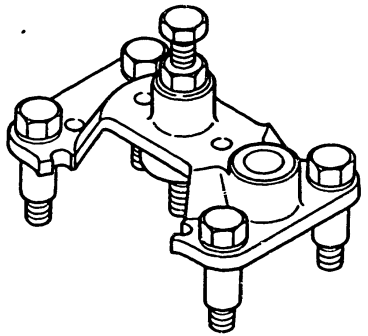


Fig. 88 Special tools for disassembly and reassembly

1 = Extractor

2 = Guide pin

3 = Block gauge

4 = Adjusting cover

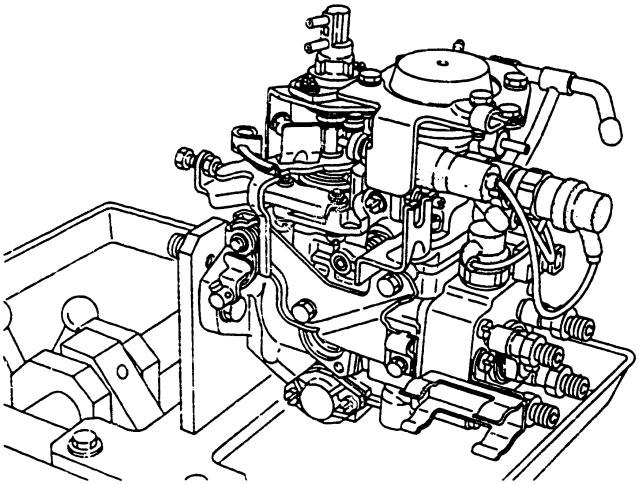


Fig. 89 Attaching the injection pump to the bracket

Disassembly

1. Attach the injection pump to the bracket (KDEP 2963) using the two bolts.

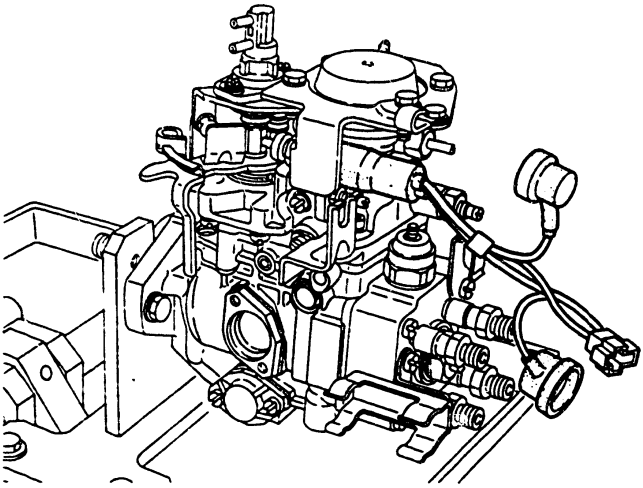


Fig. 90 Removing the external attachments

2. Remove the external attachments (fuel pipes, brackets etc.) from the injection pump.

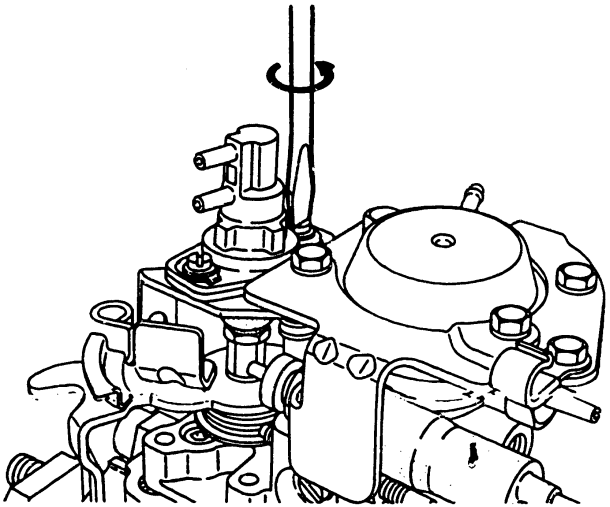


Fig. 91 Removing the V.R.V.

3. Loosen the two screws (314) and remove them together with the washers (315) to remove the V.R.V. (310; Vacuum Regulating Valve) from the bracket (67/64).

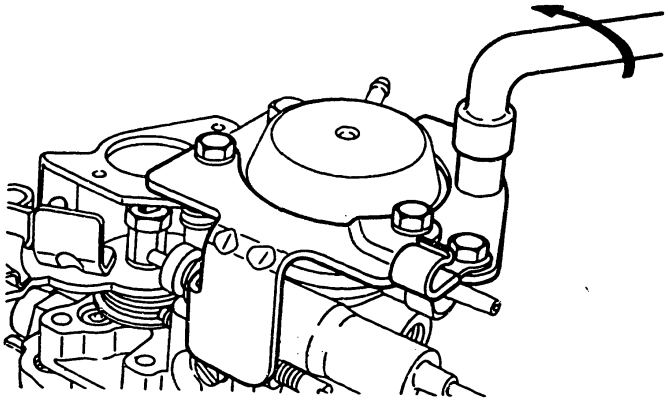


Fig. 92 Removing the brackets

4. Loosen the nut (67/100) and the four bolts (67/54, 67/55), and then remove them to remove the brackets (67/64, 67/95) and the accelerator switch (223) from governor cover.

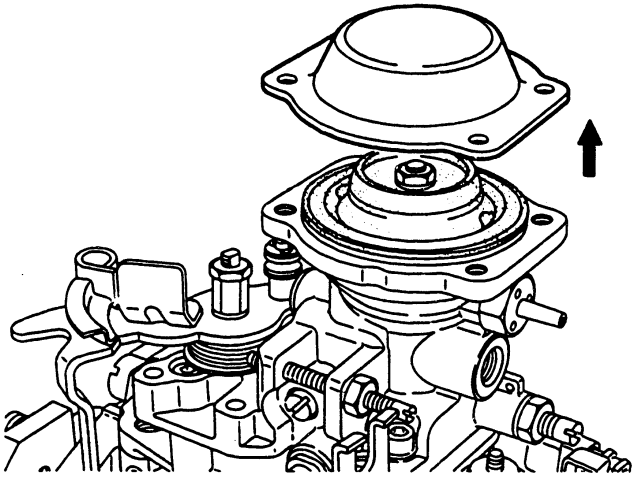


Fig. 93 Removing the cover

5. Remove the cover (67/49) from the governor cover.

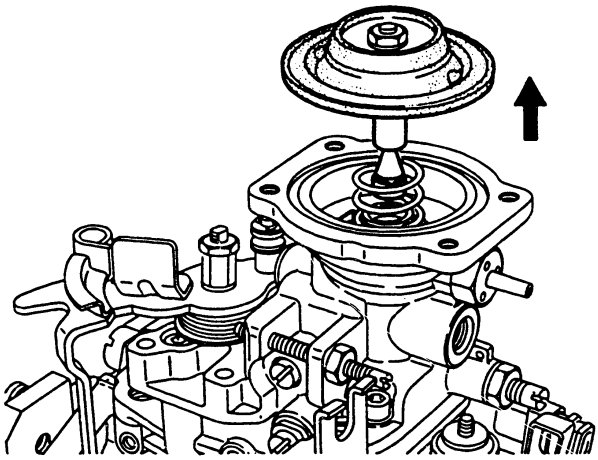


Fig. 94 Extracting the diaphragm assembly

6. Extract the diaphragm (67/43) assembly from the screw bushing (67/31) together with the spacer (67/48).

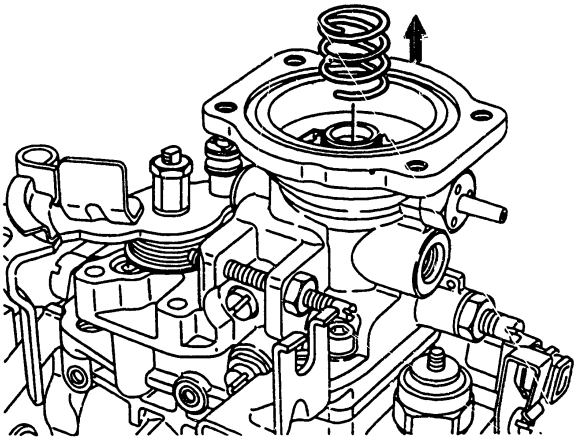


Fig. 95 Removing the spring

7. Remove the aneroid/boost compensator spring (67/47).

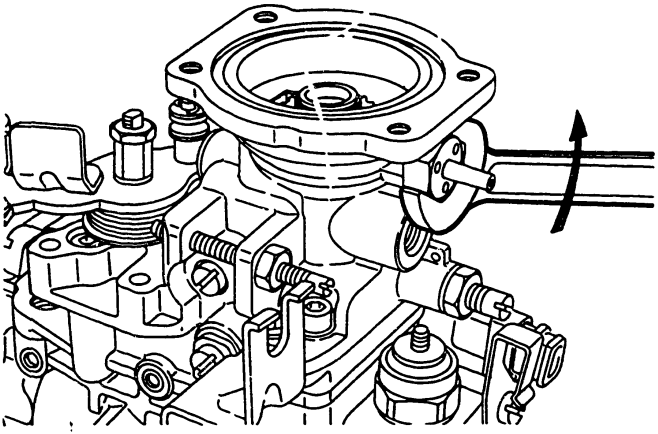


Fig. 96 Removing the connector

8. Remove the connector (67/60) to remove the ratchet nut (67/46).

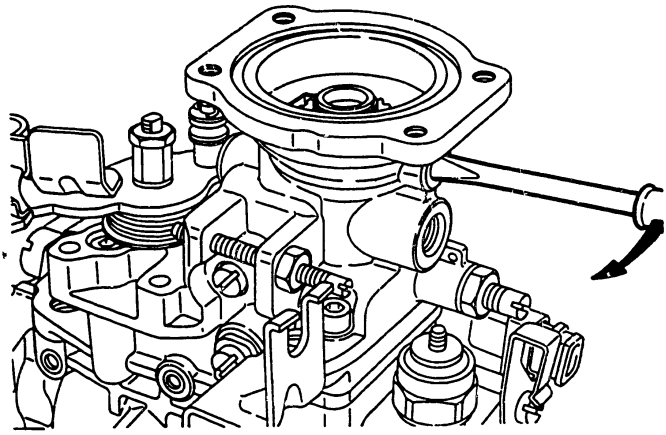


Fig. 97 Unscrewing the ratchet nut

9. Unscrew the ratchet nut (67/46) using a screwdriver inserted into the connector's (67/60) mounting hole.

Note: **The nut can be easily turned if the lock plate (67/32) under the locknut (67/33) is expanded.**

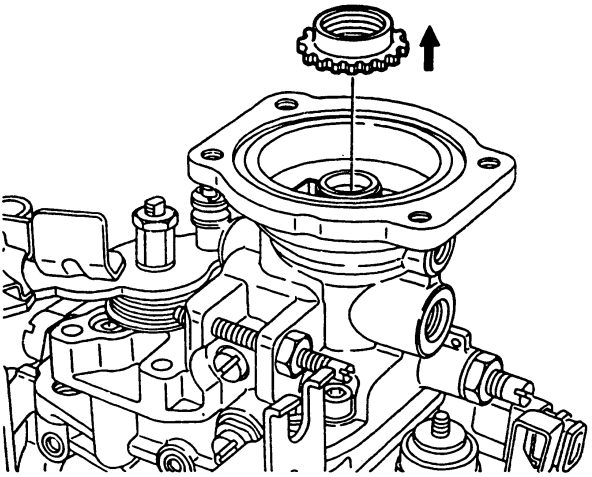


Fig. 98 Removing the ratchet nut

10. Remove the ratchet nut (67/46) from the screw bushing (67/31).

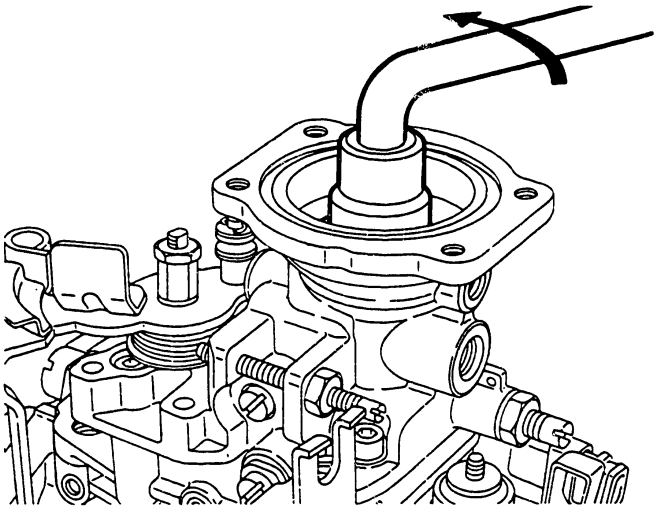


Fig. 99 Loosening the locknut

11. Loosen the locknut (67/33) securing the lock plate (67/32) and the screw bushing (67/31) using a socket wrench (SW24) and handle.

Note: The wrench's outside diameter must be less than 31 mm to prevent interference with the governor cover.

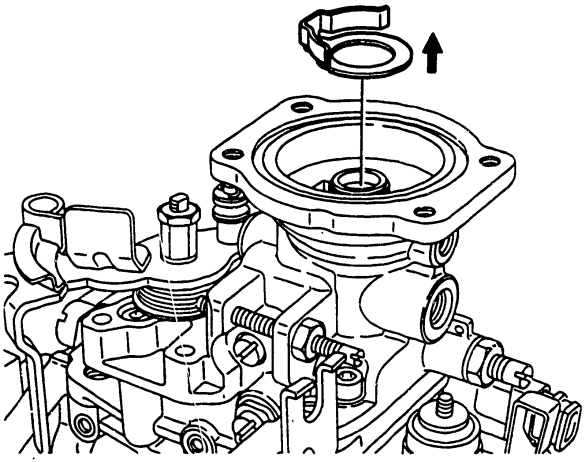


Fig. 100 Removing the lock plate

12. Remove the locknut (67/33) and lock plate (67/32) from the screw bushing (67/31).

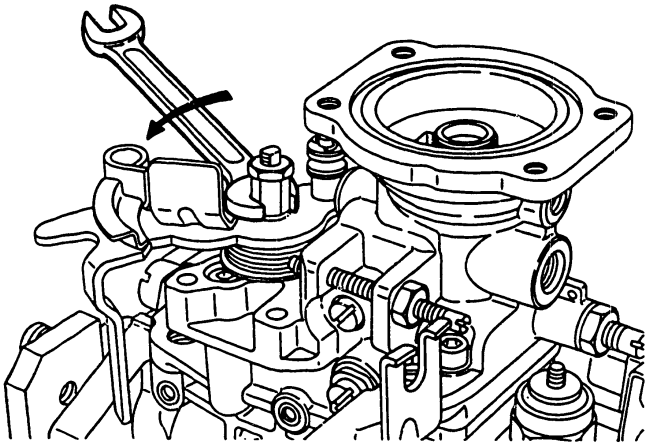


Fig. 101 Loosening the nut

13. Loosen and then remove the nut (75) fixing the control lever (72).
Then, remove the spring washer (73).

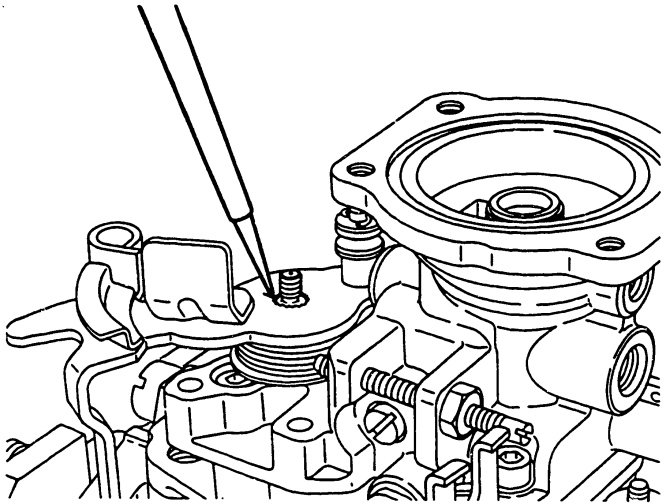


Fig. 102 Marking the control lever position

14. Mark the mounting position on the control lever (72) and the control shaft (68) to facilitate reassembly.

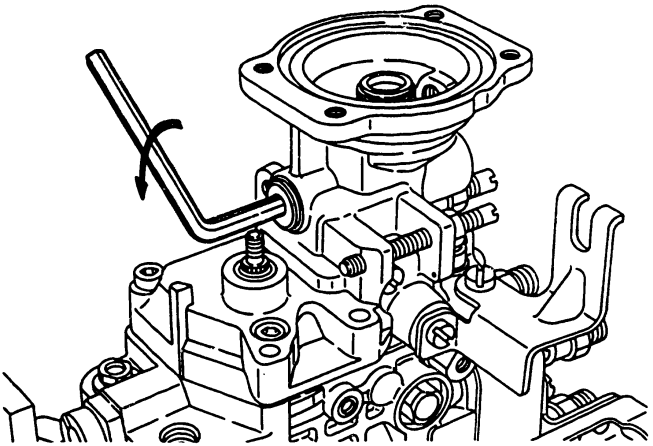


Fig. 103 Removing the plug

15. Remove the plug (67/39) and gasket (67/40) using a hexagon wrench.

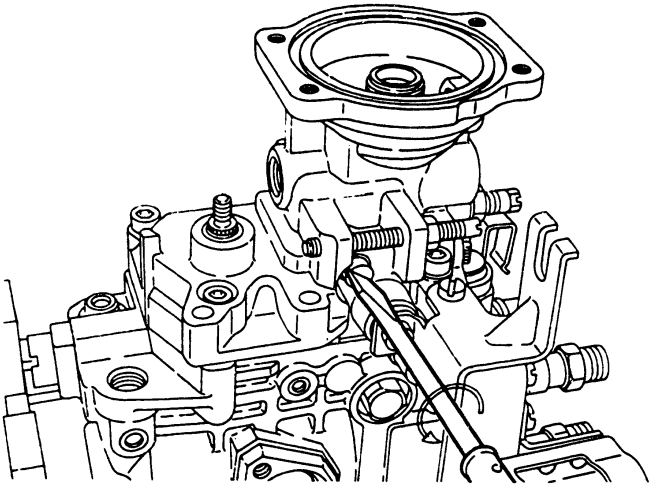


Fig. 104 Removing the screw

16. Remove the screw (67/58) and the gaskets (67/59).

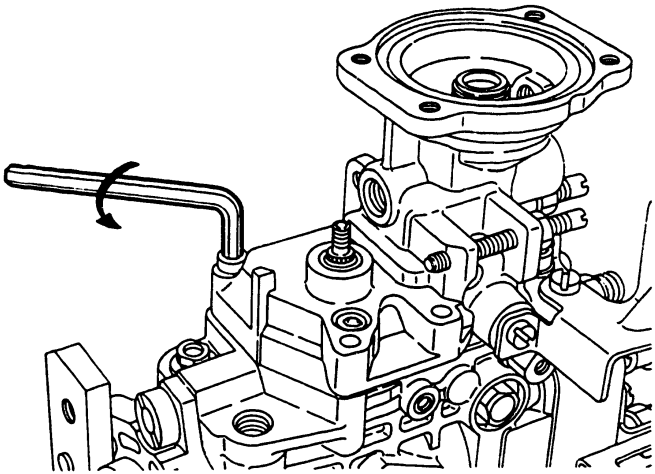


Fig. 105 Removing the socket head bolts

17. Remove the four socket head bolts (123) fixing the governor cover (67) using a hexagon wrench.

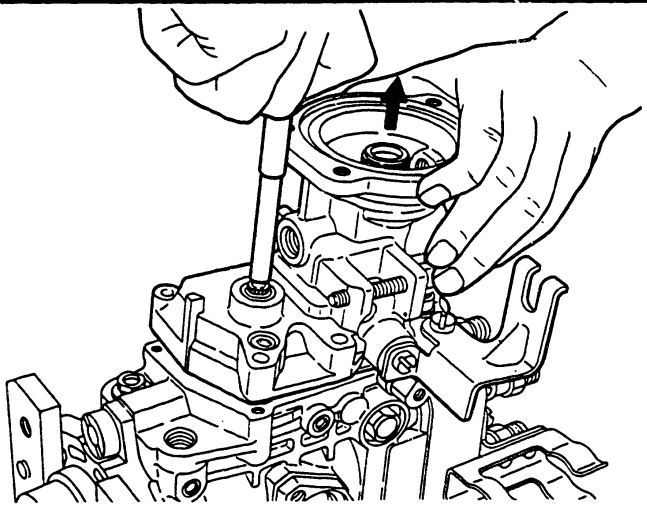


Fig. 106 Removing the governor cover

18. Remove the governor cover by lifting it while holding the control shaft with the inserter (KDEP 1096), after removing the full-load adjusting screw (88).

Note: Do not tap the control shaft using a hammer.

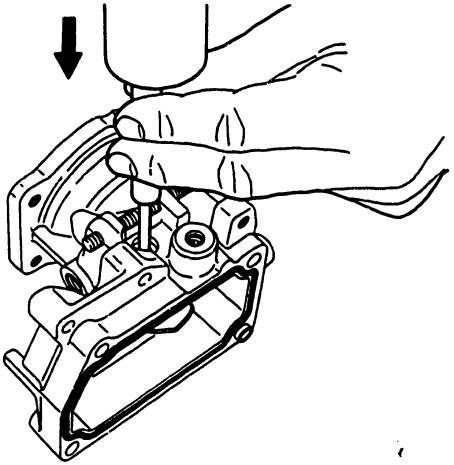


Fig. 107 Extracting the pin

19. Extract the aneroid/boost compensator lever pin (67/57) using the extractor (KDEP 2615) by tapping it with a plastic mallet from the right-hand side (viewed from the drive-side).

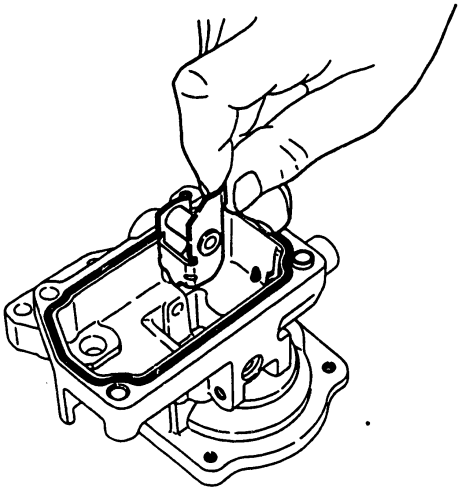


Fig. 108 Removing the lever

20. Remove the aneroid/boost compensator lever (67/56).

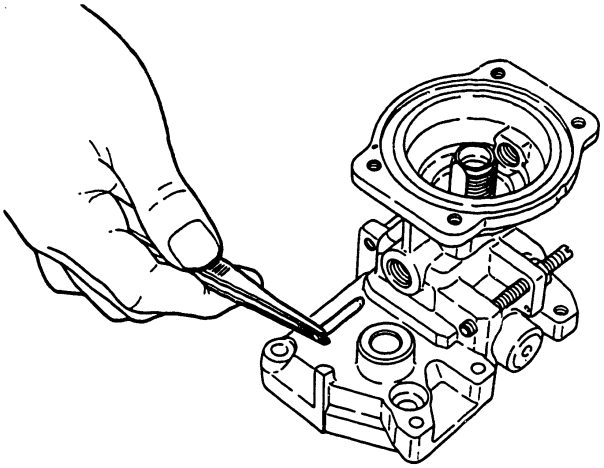


Fig. 109 Extracting the pin

21. Extract the pin (67/34) using tweezers.

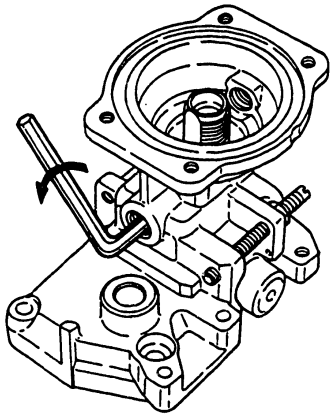


Fig. 110 Removing the nut

22. Remove the nut (67/35) using a hexagon wrench.

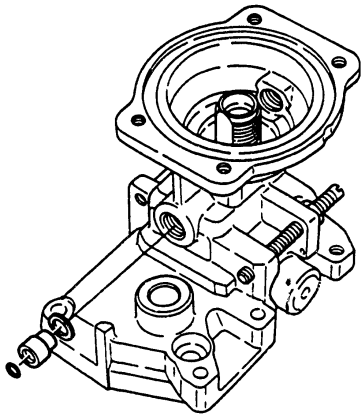


Fig. 111 Removing the bushing

23. Remove the bushing (67/37) together with the O-ring (67/36) and the gasket (67/38).

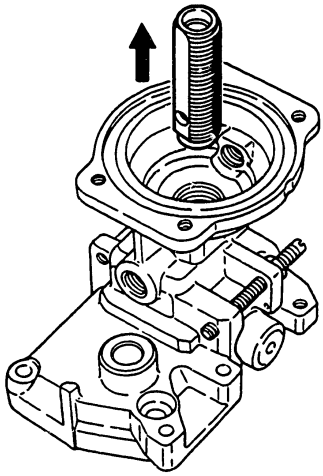


Fig. 112 Removing the screw bushing

24. Remove the screw bushing (67/31) from the governor cover.

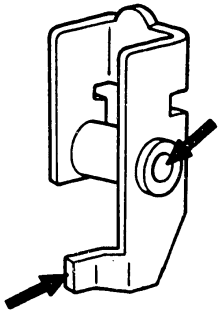


Fig. 113 Aneroid/boost compensator lever

Inspection

1. Inspect the governor cover for cracks, wear and damage to the threaded portions.
   Replace the governor cover if defective.

2. Check that the aneroid/boost compensator lever is not bent, that its surfaces contacting the pin and the governor lever are not worn excessively and that it moves smoothly and firmly on the lever pin.
   Replace the aneroid/boost compensator lever (and the lever pin) if defective. (Fig. 113)

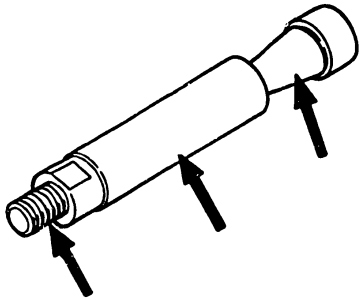


Fig. 114 Adjusting pin

3. Check that the adjusting pin's tapered portion is not worn or scratched, that the adjusting pin's sliding surface is not worn, scratched or damaged excessively and that the adjusting pin's threaded portion is not damaged.
Replace the adjusting pin if defective. (Fig. 114)

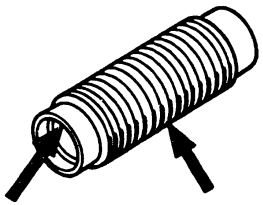


Fig. 115 Screw bushing

4. Check that the screw bushing's threaded portion is not damaged or worn and that the adjusting pin moves smoothly and firmly in the screw bushing.
   Replace the screw bushing (and the adjusting pin) if defective. **(Fig. 115)**

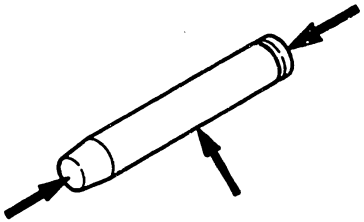


Fig. 116 Pin

5. Check that the pin's surface and both tips are not worn, scratched or damaged excessively. Replace the pin if defective. (Fig. 116)

6. Check that the aneroid/boost compensator spring is not rusted, scratched, bent or unevenly worn.
   Replace the spring if defective.

7. Inspect the other parts carefully. If they are damaged, worn, rusted or bent excessively they must be replaced.

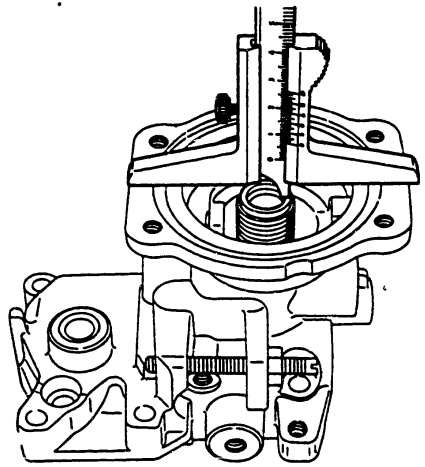


Fig. 117 Installing the screw bushing

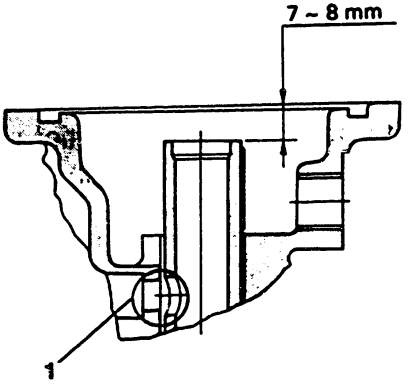


Fig. 118 Screw bushing installation position

1 = Screw bushing/governor cover hole

Reassembly

1. Install the screw bushing (67/31) so that the distance between the tip of the screw bushing and the face of the governor cover is 7.0 to 8.0 mm.

   Ensure that the screw bushing hole is aligned with the hole shown in Fig. 118. (Figs. 117 and 118)

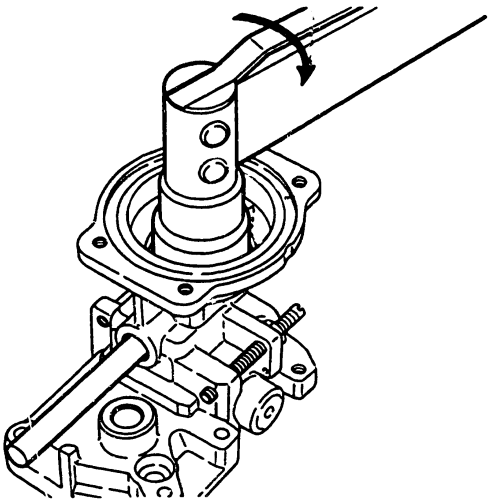


Fig. 119 Tightening the locknut

2. Tighten the locknut (67/33) to fix the screw bushing (67/31) and the lock plate (67/32) to the specified torque while using the special tool (KDEP 2617) to ensure that the screw bushing does not move from the above position. (Fig. 119)

   Specified tightening torque: 2.5 to 3.5 kg.m

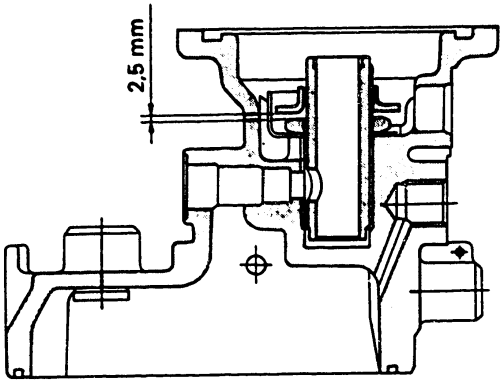


Fig. 120 Ratchet nut installation position

3. Screw the ratchet nut (67/46) in the screw bushing (67/31) so that the distance between the locknut's (67/33) end face and the ratchet nut's bottom face is approximately 2.5 mm. To do this, fully tighten the ratchet nut and then back off the ratchet nut two and a half turns (as its pitch is 1 mm).

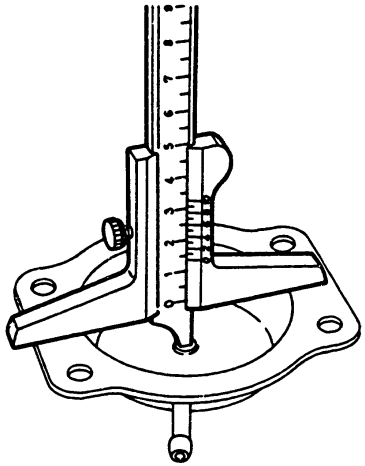


Fig. 121 Measuring the distance ℓ_1

4. Adjust the aneroid/boost compensator stroke using the spacer (67/48). Calculate its thickness as described below.

-1. Measure the distance ℓ_1 between the tip of the indentation in the cover (67/49) and the inside face of the cover (67/49). (Fig. 121)

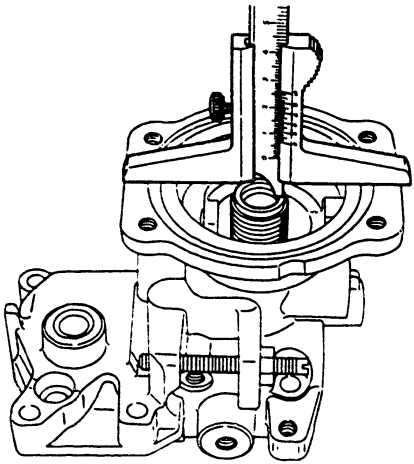


Fig. 122 Measuring the distance ℓ_2

-2. Measure the distance ℓ_2 between the tip of the screw bushing (67/31) and the face of the governor cover.

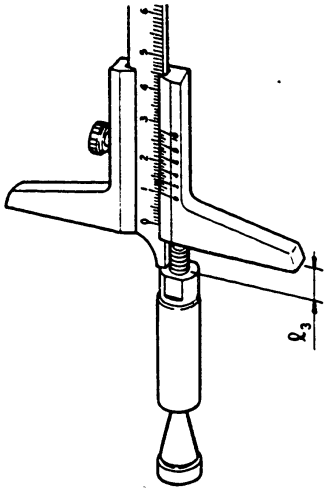


Fig. 123 Measuring the distance ℓ_3

-3. Measure the length ℓ_3 of the adjusting pin's threaded portion. (Fig. **123**)

-4. After measuring the above dimensions calculate the thickness of the spacer (67/48) using the following formula.

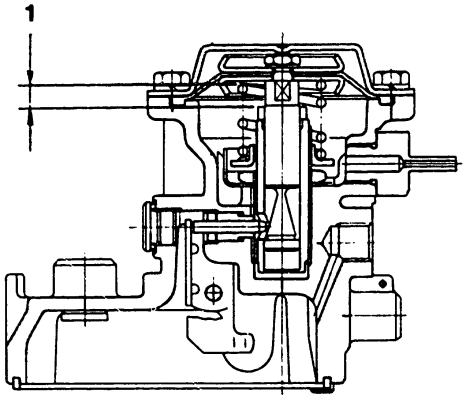


Fig. 124 Aneroid/boost compensator stroke

1 = A.B.C. stroke

Aneroid/boost compensator stroke
$= \ell_1 + \ell_2 - \ell_3 -$ Spacer thickness

Therefore,
Spacer thickness $= \ell_1 + \ell_2 - \ell_3 -$ Aneroid/boost compensator stroke

If the spacer thickness calculated from the above formula differs from the thickness of the spacer previously installed, replace the spacer so that the aneroid/boost compensator stroke is as specified. (Fig. 124)

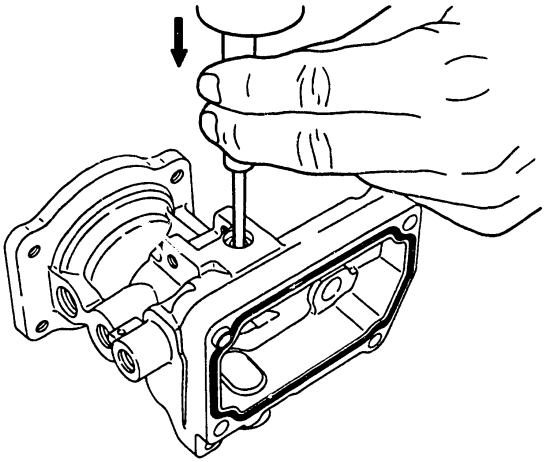


Fig. 125 Pressfitting the pin

5. Pressfit the aneroid/boost compensator lever pin (67/57), using the extractor (KDEP 2615) and a plastic mallet, from the left-hand side (viewed from the drive side) to install the aneroid/boost compensator lever (67/56) in the housing.

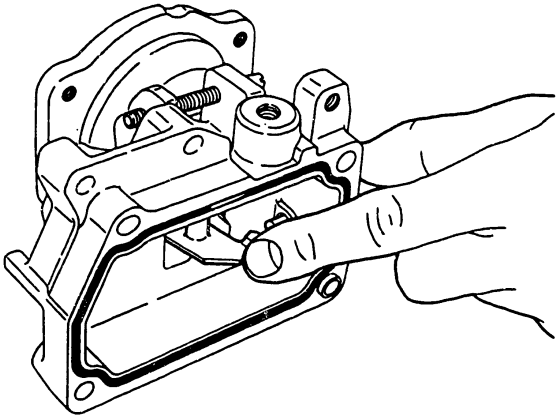


Fig. 126 Checking lever movement

6. Ensure that the aneroid/boost compensator lever moves smoothly.

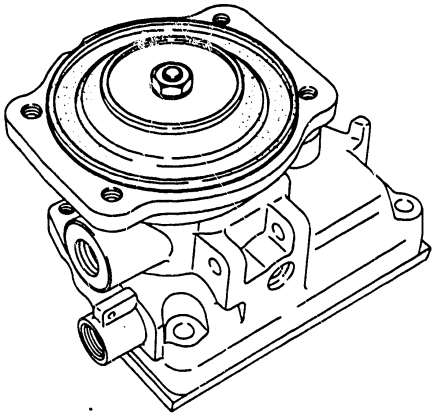


Fig. 127 Installing the aneroid/boost compensator parts

7. Adjust the aneroid/boost compensator lever position as described below.

-1 Install all internal aneroid/boost compensator parts. (Fig. 127)

Note: The diaphragm must be replaced with a new one.

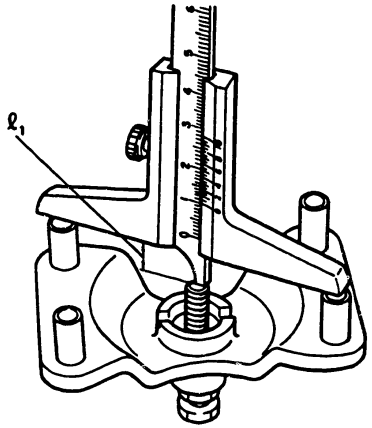


Fig. 128 Adjusting the stopper bolt position

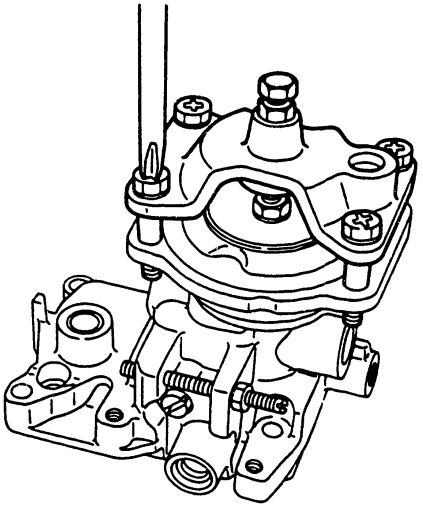


Fig. 129 Installing the cover

-2 Install the adjusting cover to the aneroid/boost compensator after adjusting the cover's stopper bolt installation position so that the distance between the tip of the stopper bolt and the tip of the adjusting cover is ℓ_1 (as measured in 4 - 1 above) minus 3.0 mm.

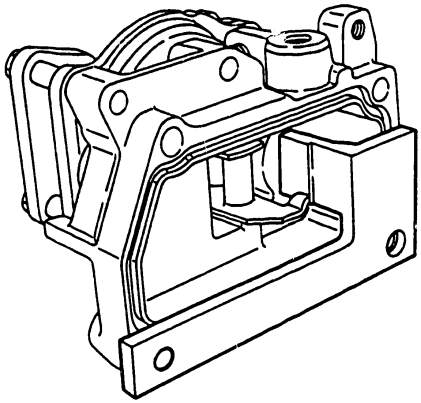


Fig. 130 Attaching the block gauge

-3 Securely attach the block gauge (KDEP 1152) to the governor cover as shown in Fig. 130.

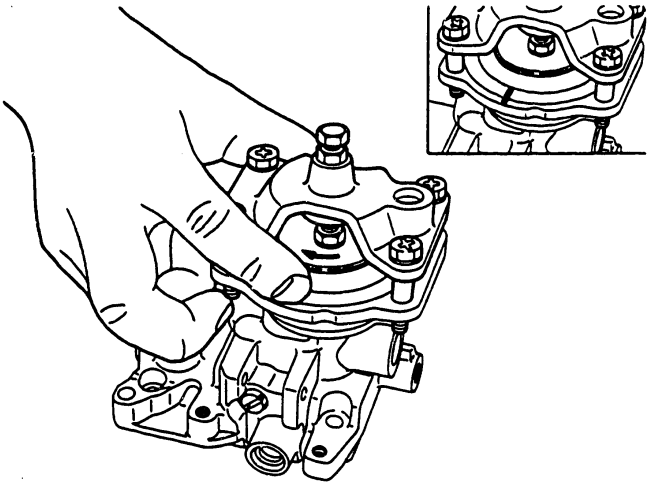


Fig. 131 Rotating the diaphragm assembly

-4 Rotate the diaphragm assembly by hand until increased resistance to rotation is felt.

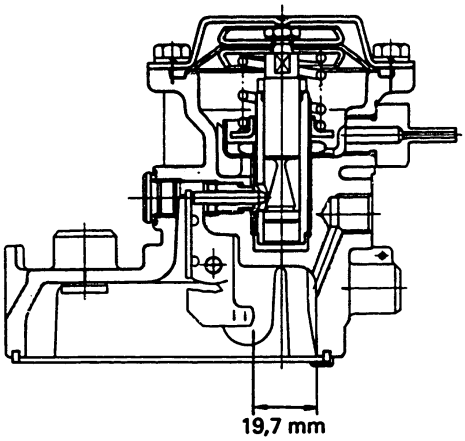


Fig. 132 Aneroid/boost compensator lever position

-5. Then, ensure that the tip of the aneroid/boost compensator lever flange contacts the block gauge.
The aneroid/boost compensator lever should now be in a position where the distance between the tip of the aneroid/boost compensator lever flange and the inside face of the governor cover is 19.7 mm.

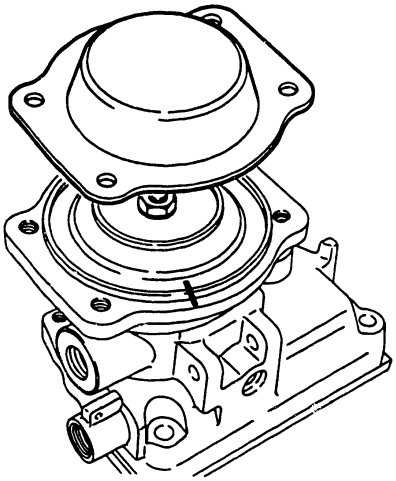
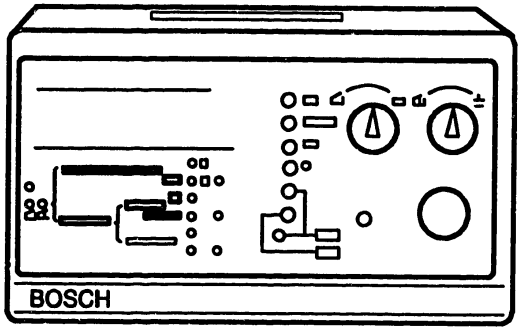


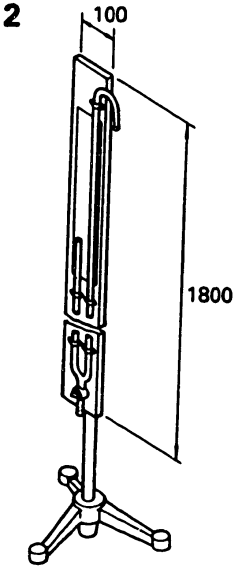
Fig. 133 Installing the cover

8. After removing the adjusting cover and the block gauge, install the cover to fix the diaphragm assembly while ensuring that the diaphragm assembly does not move.

1



2



3

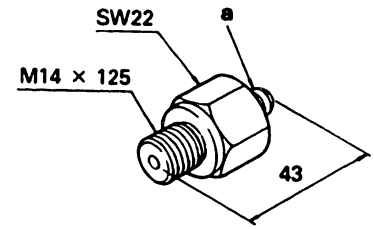


Fig. 134 Special tools for adjustment

a = U3/8" 24 threads

Special Tools for Adjustment

No.	Part No.	Part Name	Q' ty	Remarks
1	0 684 200 610	Pressure control kit	1	For adjusting A.B.C.S.
2	commerc. available	Mercury manometer	1	For adjusting V.R.V. and regulator
3	commerc. available	Adapter	1	For measuring pump chamber pressure

In addition to the above, a vacuum pump, a vacuum regulator and a vacuum gauge are necessary.

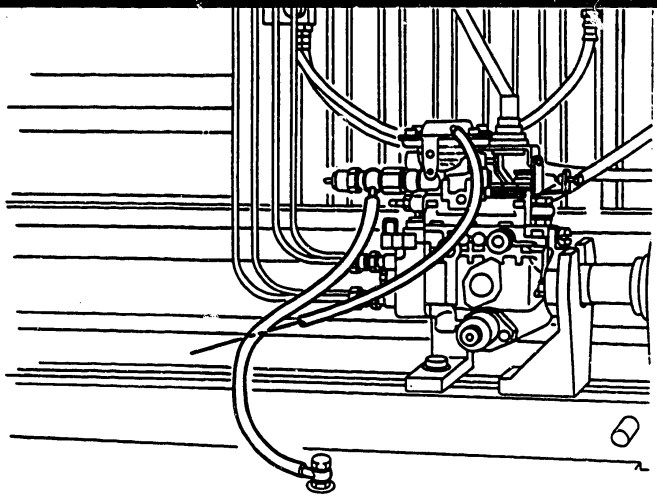


Fig. 135 Connecting the air pipes

Adjustment

1. Connect the air pipes to the injection pump using the pressure control kit (0 684 200 610).

Note: The pressure control kit is necessary as a compressed air source.

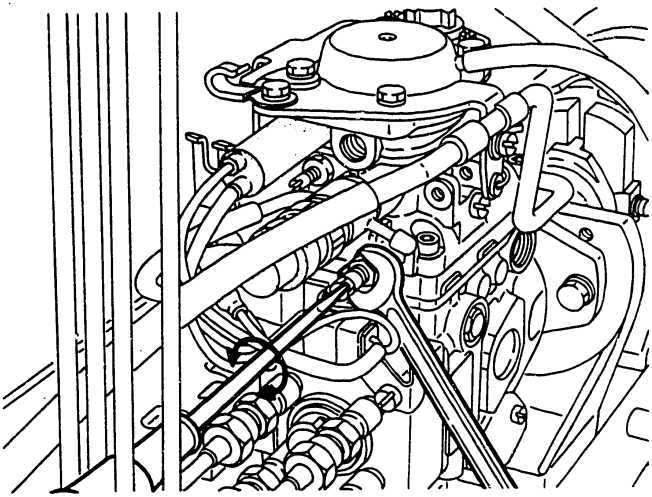


Fig. 136 Full-load injection quantity adjustment

2. After setting the control lever at the maximum-speed position, adjust the full-load injection quantity according to the calibration data using the full-load adjusting screw, while supplying the specified boost pressure.

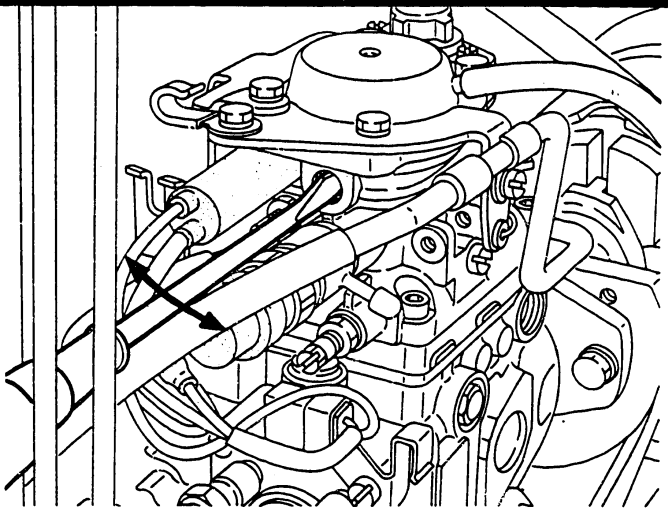


Fig. 137 Full-load injection quantity adjustment

3. Readjust the full-load injection quantity by adjusting the ratchet nut position, while supplying the specified boost pressure.

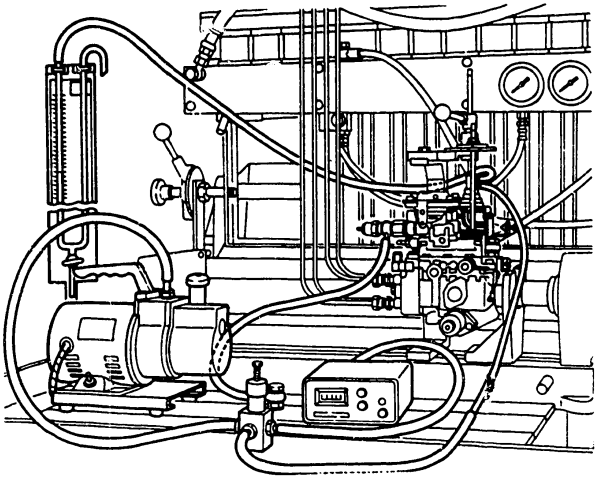


Fig. 138 Air piping

4. Adjust the V.R.V. as described below

-1. Connect the vacuum pump, the vacuum regulator, the vacuum gauge, the mercury manometer, the V.R.V. and the air pipes.

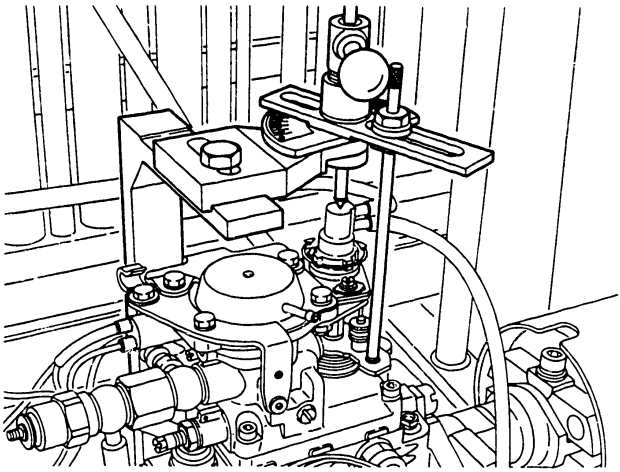


Fig. 139 Adjusting the V.R.V. position

-2. Fix the control lever at the position where the injection quantity is as specified.

-3. Then, while supplying the specified negative pressure, adjust the V.R.V. position using its elongated slot so that the V.R.V. outlet's negative pressure is as specified. (Fig. 139)

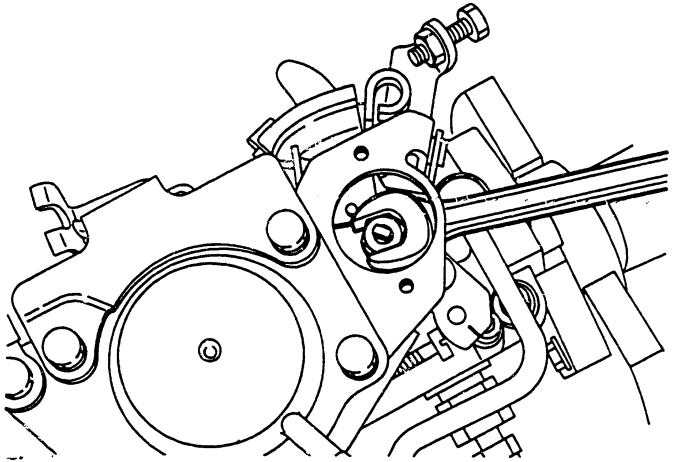


Fig. 140 Adjusting the V.R.V. bolt

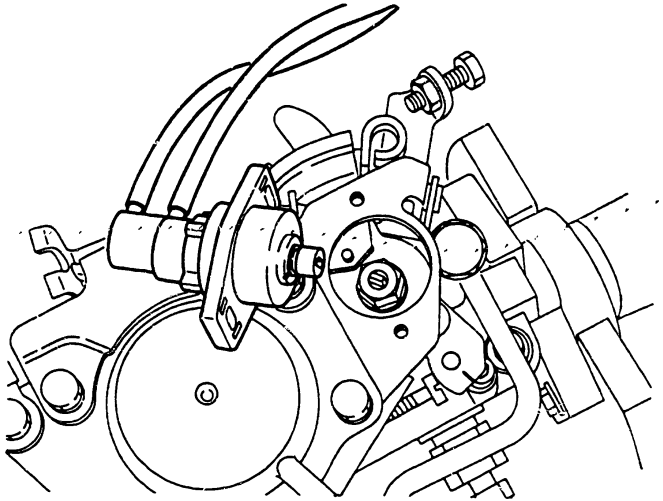


Fig. 141 Reinstalling the V.R.V.

-4 If it can not be adjusted using only the elongated slot, adjust the position of the adjusting bolt, which is installed at the top of the control lever fixing nut, and then readjust the V.R.V. position.

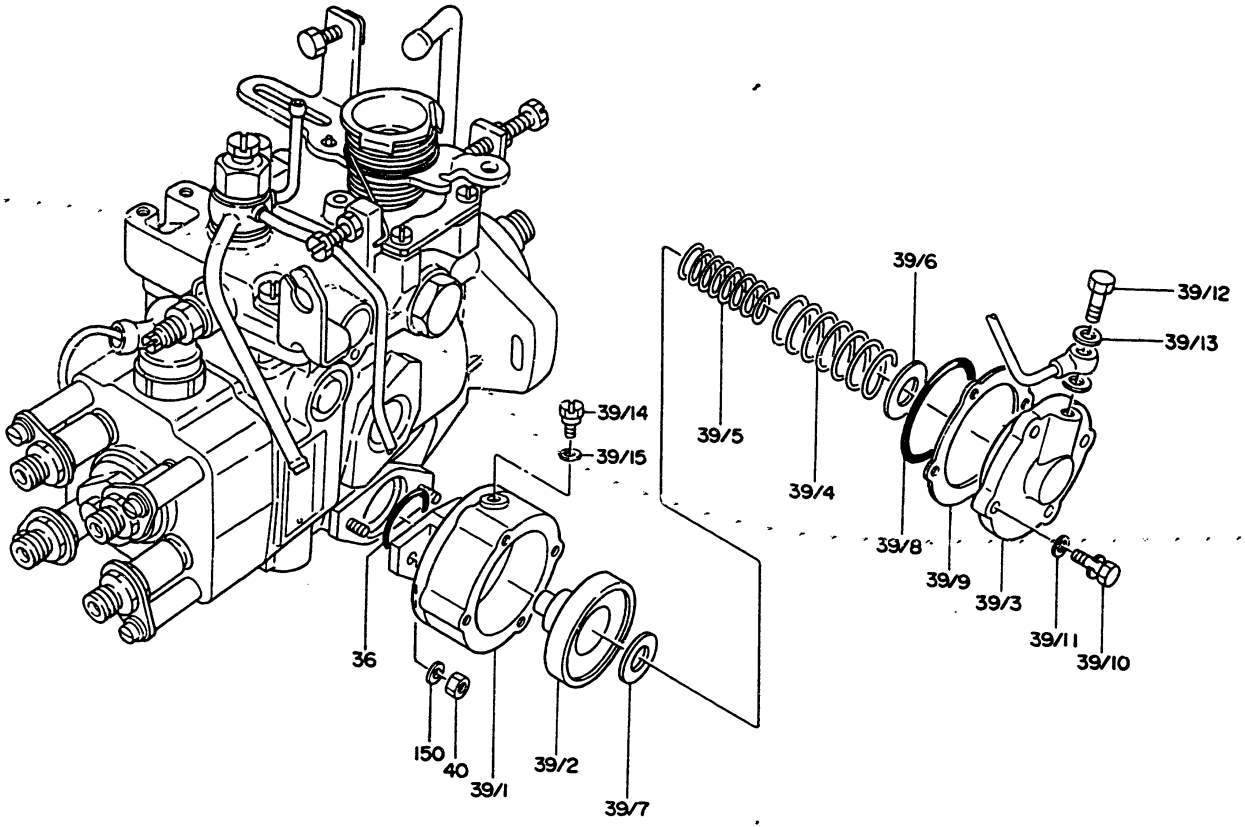


Fig. 142 Cold start device: exploded view

COLD START DEVICE (C.S.D.)

Figure 142 shows an exploded view of the cold start device.

Special Tools for Disassembly and Reassembly

No special tools for the disassembly and reassembly of the cold start device are necessary, except for the tools described in "GENERAL".

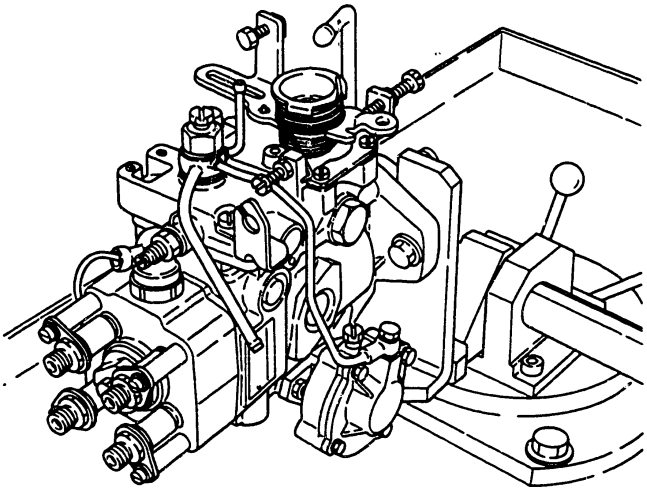


Fig. 143 Attaching the injection pump to the bracket

Disassembly

1. Attach the injection pump to the bracket (KDEP 2963) using the two bolts.

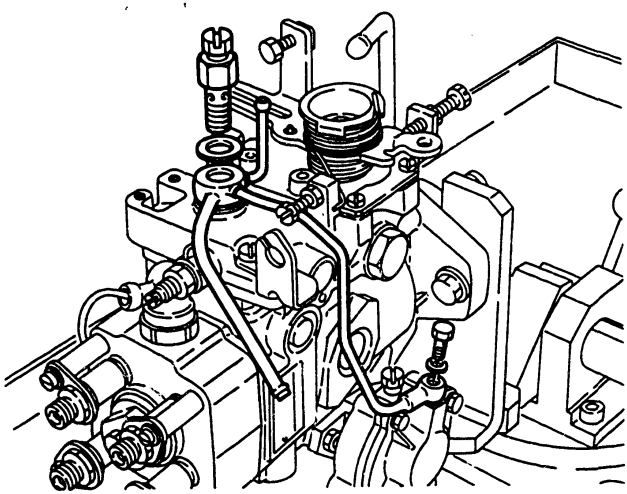


Fig. 144 Removing the external attachments

2. Remove the external attachments (fuel pipes, brackets etc.) from the injection pump.

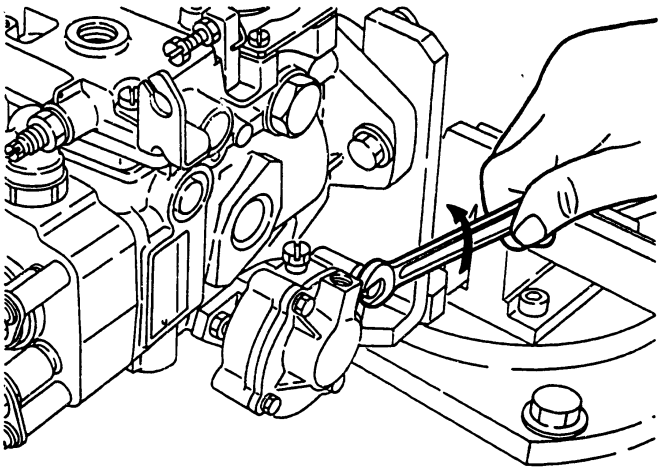


Fig. 145 Removing the bolts

3. Remove the four bolts (39/10) fixing the cover (39/3).

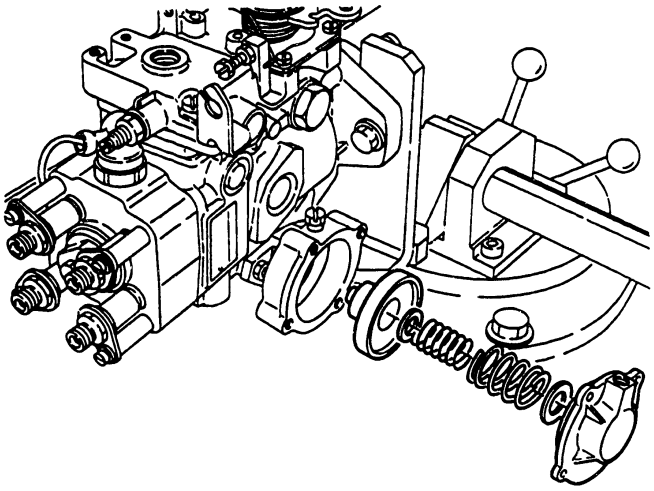


Fig. 146 Removing the inner parts

4. Remove the two springs (39/3, 39/4) and then extract the piston (39/2) from the housing (39/1).

Note: There are shims (39/7) on both sides of the springs.

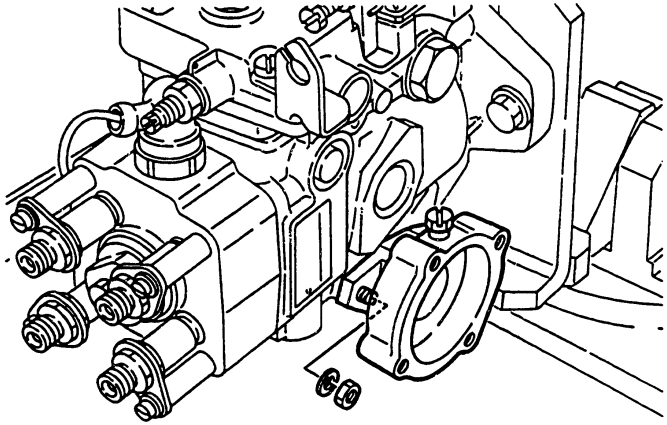


Fig. 147 Removing the housing

5. Remove the two nuts (40) to remove the housing (39/1).

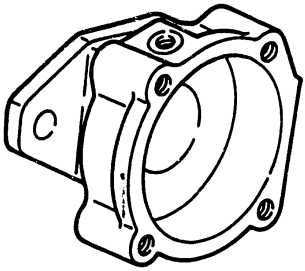


Fig. 148 C.S.D. housing

Inspection

1. Check that the cold start device housing is not damaged or cracked, and that its sliding surface is not worn, scratched or damaged excessively. Replace the housing if defective.

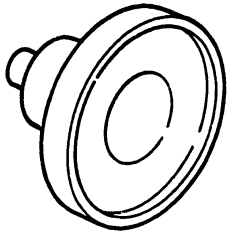


Fig. 149 C.S.D. piston

2. Check that the cold start device piston's sliding surface is not worn, scratched or damaged excessively, that the piston tip is not worn or damaged excessively and that the piston and the housing are not loose.
   Replace the piston (and the housing) if defective. (Fig. 149)

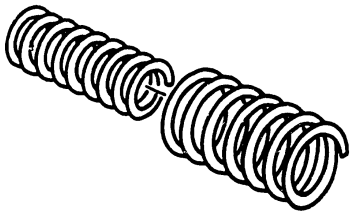


Fig. 150 C.S.D. springs

3. Check that the cold start device springs are not rusted, scratched, bent or unevenly worn. Replace the springs if defective. (Fig. 150)

4. Inspect the other parts carefully. If they are damaged, worn, rusted or bent excessively they must be replaced.

Reassembly

The reassembly procedure is the reverse of the disassembly procedure.

Special Tools for Adjustment

No special tools for the adjustment of the cold start device are necessary, except for the tools described in "GENERAL".

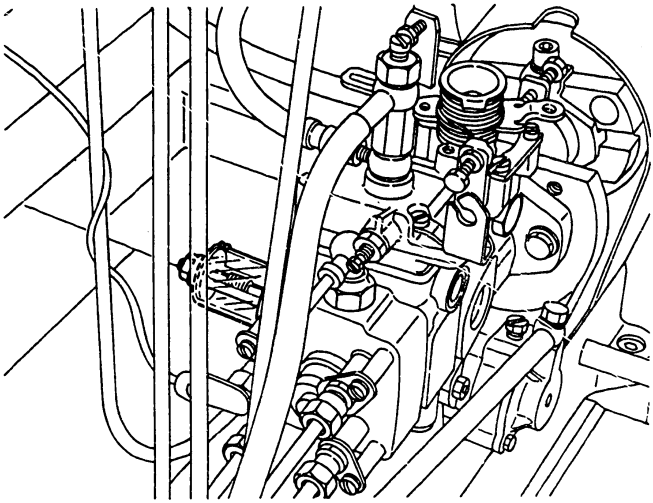


Fig. 151 Preparation

Adjustment

1. Install the measuring device (KDEP 2601) to the timer's low pressure side and connect the fuel oil overflow pipe to the cold start device.

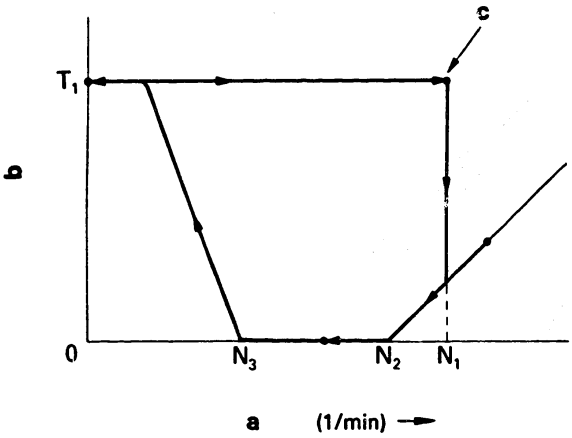


Fig. 152 C.S.D. performance chart

a = Pump speed
b = Advance angle (deg.)
c = Release point

2. Maintain the injection pump speed between N_2 and N_3 after once increasing the injection pump speed beyond N_1 (release speed) to cancel the cold start device function.
   Then, using the measuring device, ensure that the timer's stroke is zero.

3. Ensure that the timer's advance angle is T_1 after stopping the injection pump.

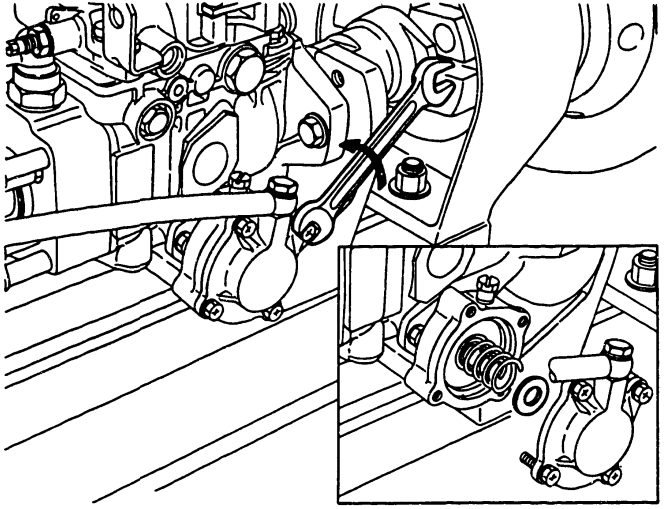


Fig. 153 Replacing the shim

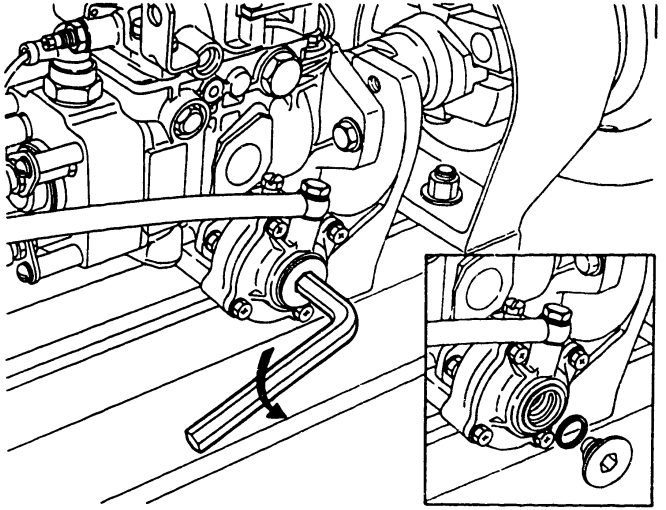


Fig. 154 Replacing the shim

4. Gradually increase the injection pump speed and adjust the release speed by replacing the shim so that the cold start device function is relieved at the specified speed.

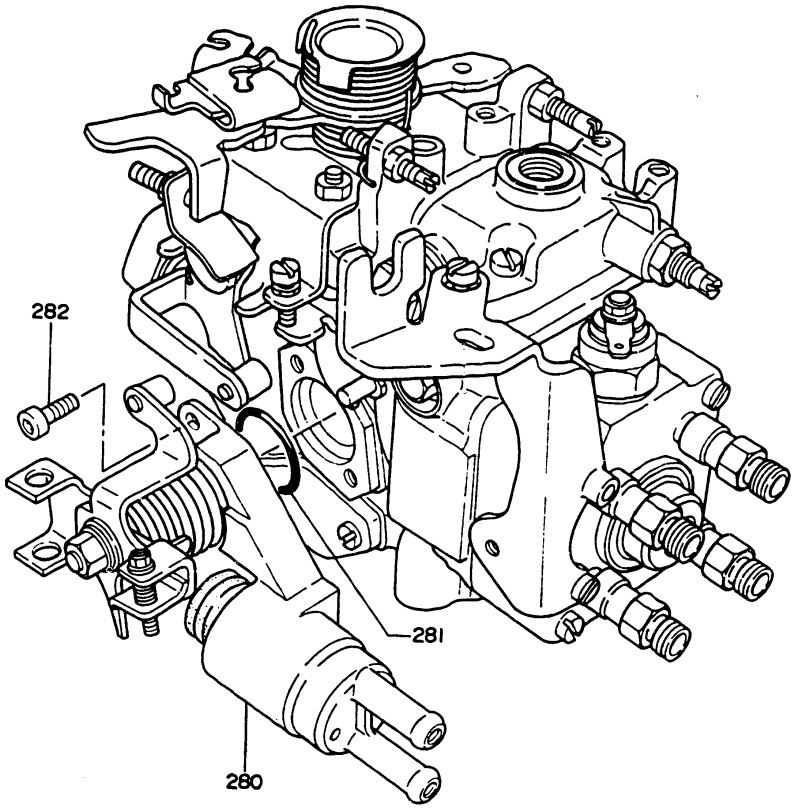


Fig. 155 Wax-Cold Start Device equipped VE Pump

WAX-COLD START DEVICE (W-C.S.D.)

Figure 155 shows an exploded view of the injection pump equipped with the wax-cold start device.

Special Tools for Disassembly and Reassembly

No special tools for the disassembly and reassembly of the wax-cold start device are necessary, except for the tools described in "GENERAL".

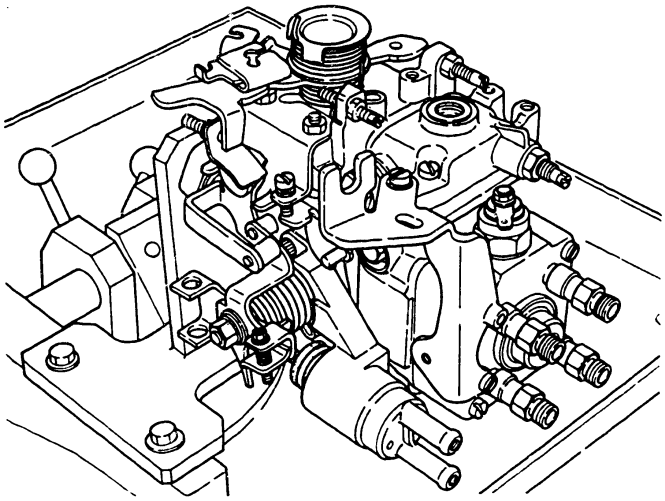


Fig. 156 Attaching the injection pump to the bracket

Disassembly

1. Attach the injection pump to the bracket (KDEP 2963) using the two bolts.

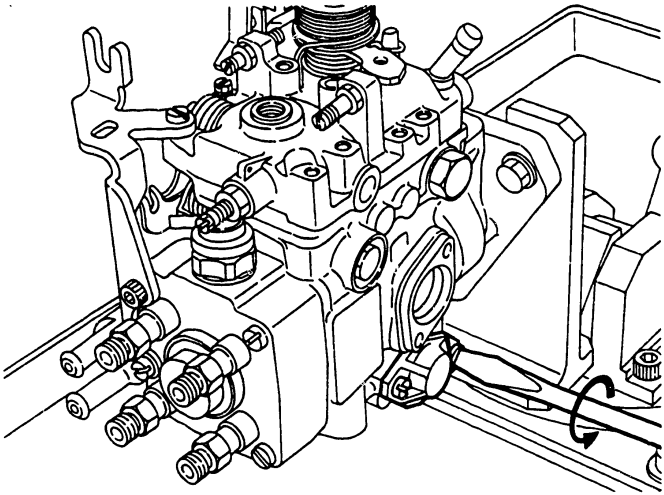


Fig. 157 Removing the cover

2. Remove the two screws (38) to remove the low pressure side timer cover (37). (Fig. 157)

Note: Take care not to lose the shim(s) in the cover.

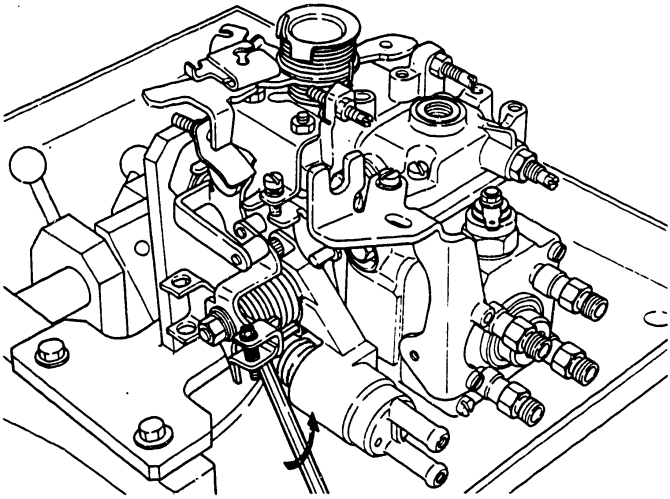


Fig. 158 Removing the wax-cold start device

3. Remove the two screws (282), using a hexagon wrench, to remove the wax-cold start device (280) from the injection pump. (Fig. 158)

Note: As the wax-cold start device must be handled as a single component, it can not be disassembled.

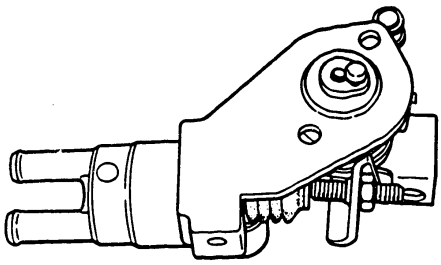


Fig. 159 W-C.S.D assembly

Inspection

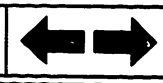
1. Check that the wax-cold start device assembly's levers, springs, ball pin and attaching face are not worn, damaged or scratched excessively.
   Replace the wax-cold start device assembly if defective. (Fig. 159)
2. Inspect the other parts carefully. If they are damaged, worn, rusted or bent excessively they must be replaced.

Reassembly

The reassembly procedure is the reverse of the disassembly procedure.

Special Tools for Adjustment

No special tools for the adjustment of the wax-cold start device are necessary, except for the tools described in "GENERAL".



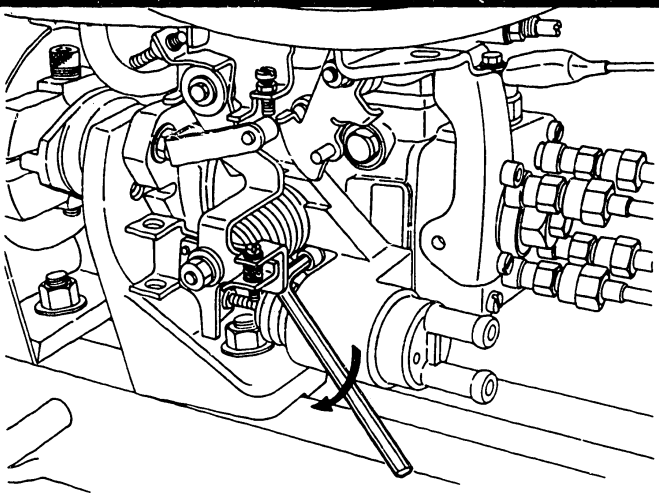


Fig. 160 Installing the W-C.S.D.

Adjustment

1. Perform the wax-cold start device adjustment with the injection pump temperature equal to the ambient temperature, or ensure that a period of approximately 30 minutes has passed since the completion of injection pump adjustment.

2. Install the measuring device (KDEP 2601) to the timer's low pressure side.

3. Install the wax-cold start device in its original position. (Fig. 160)

Note: During other adjustments, the wax-cold start device is removed and the timer's high pressure side cover is installed in place of the wax-cold start device.

4. Rotate the wax-cold start device lever using a screwdriver to cancel its function and then maintain it in this position.

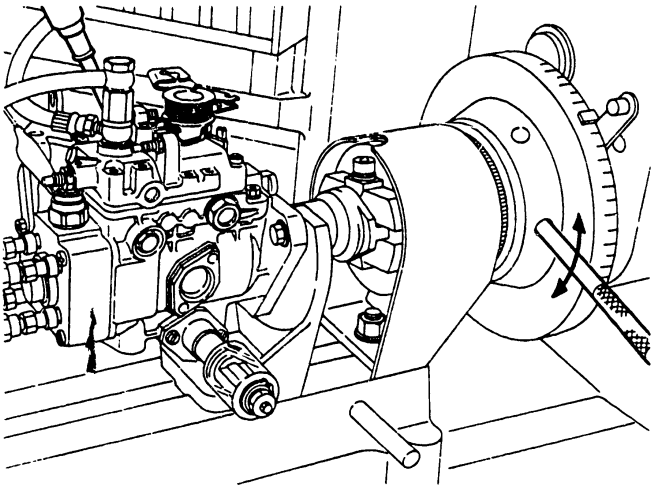


Fig. 161 Setting the zero point

5. While rotating the drive shaft ensure, using the measuring device, that the timer's stroke is zero (Fig. 161)
   Then, return the wax-cold start device lever to its original position.

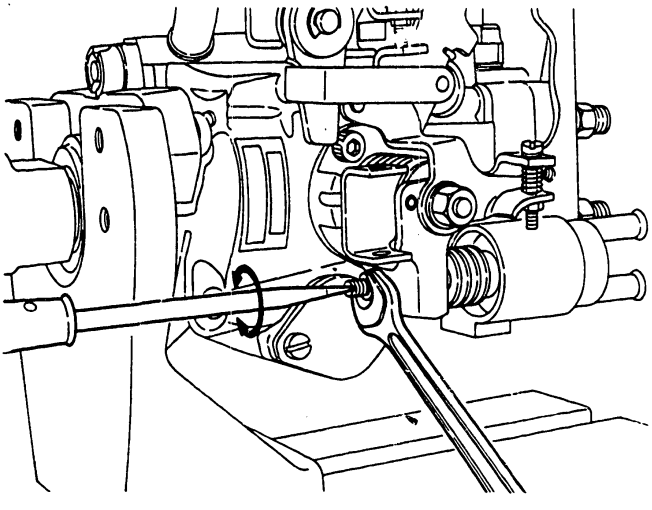


Fig. 162 Setting the adjusting screw

6. Find the timer stroke and control lever position from the graph indicating the relationship between ambient temperature and timer stroke or control lever position.

7. Adjust the timer's starting advance angle (i.e. timer stroke at starting) by turning the adjusting screw of the wax-cold start device so that the timer stroke is as specified (i.e. the above value) for the ambient temperature. (Fig. 162)

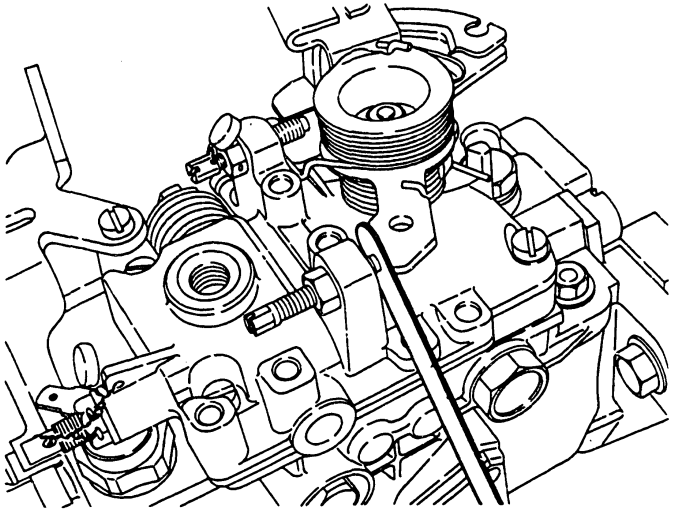


Fig. 163 Inserting the thickness gauge

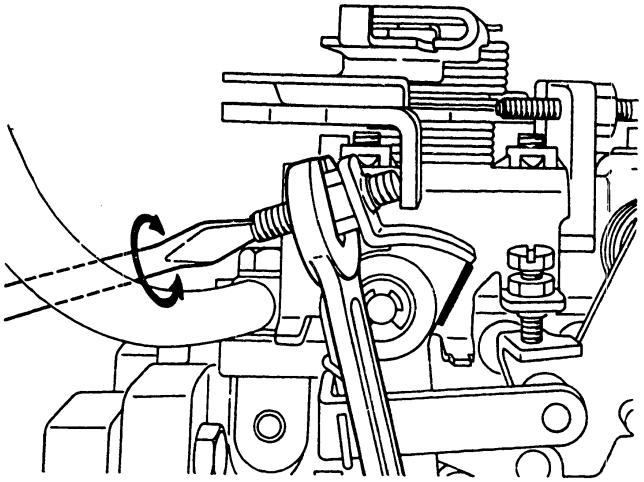


Fig. 164 Setting the adjusting screw

8. Insert a thickness gauge between the tip of the idle adjusting screw and the control lever so that the distance is as specified in the calibration data.

   Then, after setting the link lever position so that the edge of the link lever is parallel with the aligning mark on the bracket fixing the link lever, adjust the adjusting screw in the link lever so that its position is as specified in the calibration data. (Figs. 163 and 164)

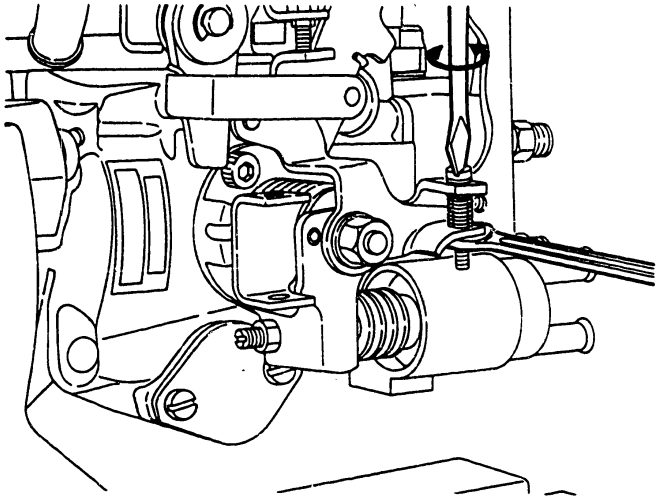


Fig. 165 Setting the adjusting screw

9. Adjust the control lever position for fast-idling by turning the wax-cold start device's adjusting screw so that the distance between the tip of the idling adjusting screw and the control lever is as specified for the ambient temperature (specified above in item 6).

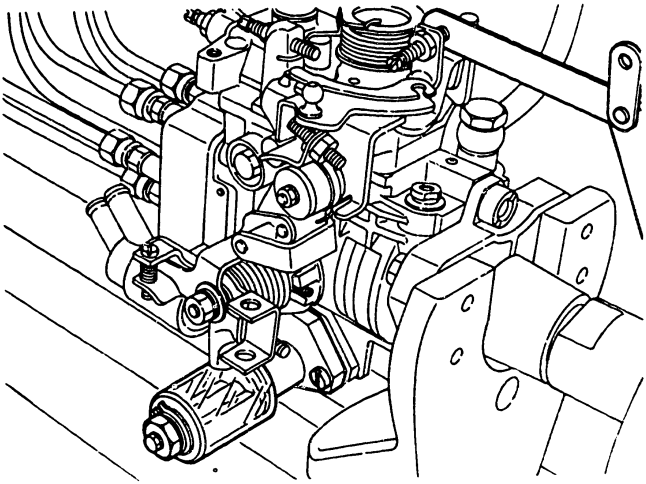


Fig. 166 Measuring device installation

10. With the servo valve timer, as the measuring device (KDEP 2601) used to measure the timer stroke can not be installed on the timer's low pressure side, install the measuring device (1 688 130 139) upside-down on the timer's high pressure side.

    Then, perform the same adjustment, procedures as above.

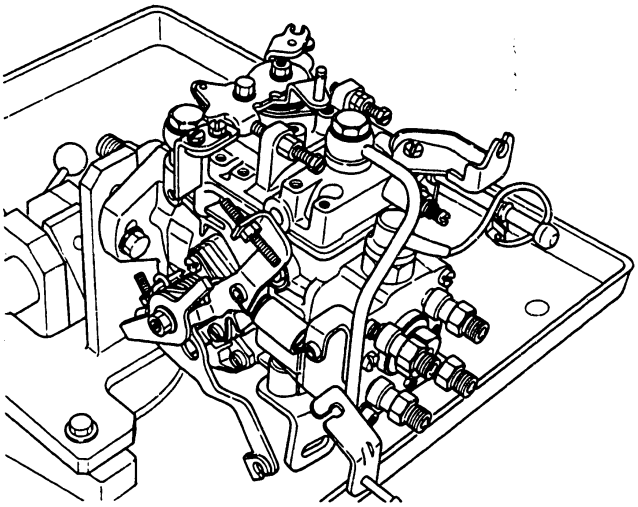


Fig. 167 Attaching the injection pump to the bracket

MANUAL-COLD START DEVICE (M-C.S.D.)

Disassembly

1. Attach the injection pump to the bracket (KDEP 2963) using the two bolts.

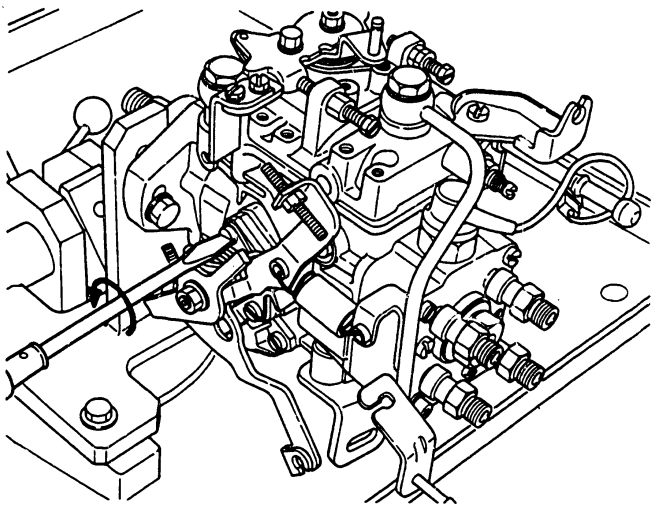


Fig. 168 Removing the screws

2. Remove the two screws (282) to remove the manual-cold start device from the injection pump. (Fig. 168)

Note: As the manual-cold start device must be handled as a single component, it can not be disassembled.

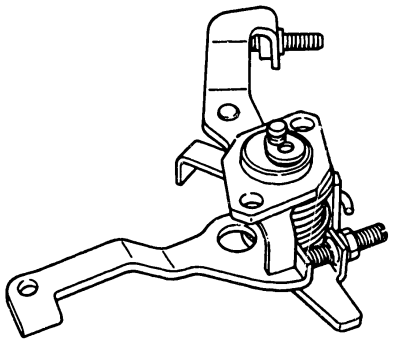


Fig. 169 M-C.S.D assembly

Inspection

1. Check that the manual-cold start device assembly's levers, springs, ball pin and attaching face are not worn, damaged or scratched excessively.
   Replace the manual-cold start device assembly if defective. (Fig. 169)
2. Inspect the other parts carefully. If they are damaged, worn, rusted or bent excessively they must be replaced.

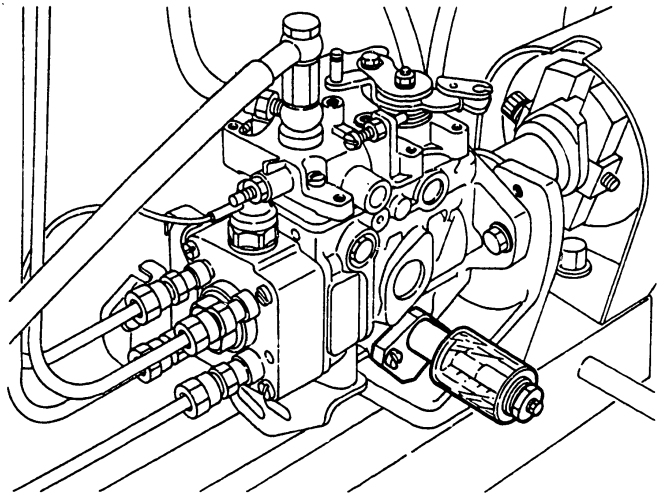


Fig. 170 Preparation

Reassembly

The reassembly procedure is the reverse of the disassembly procedure.

Adjustment

1. Install the measuring device (1 688 130 139) to the timer's high pressure side (Fig. 170)

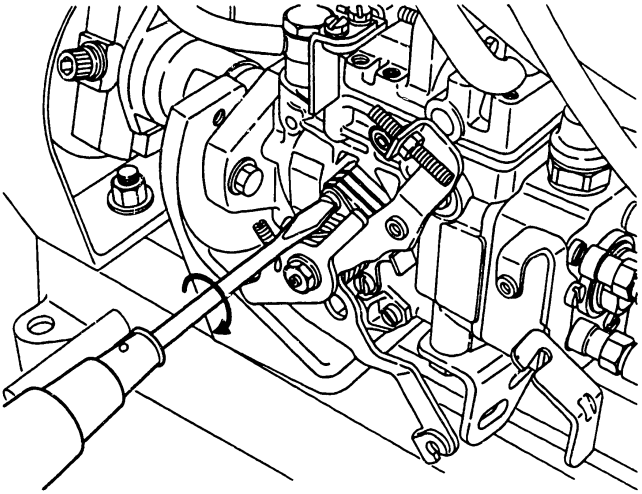


Fig. 171 Installing the manual-cold start device

2. Install the M-C.S.D. in its original position after confirming that the timer stroke reading on the measuring device returns to zero when the drive shaft is rotated (Fig. 171)

Note: During other adjustments, the M-C.S.D. is removed and the timer's high pressure side cover is installed in place of the M-C.S.D.

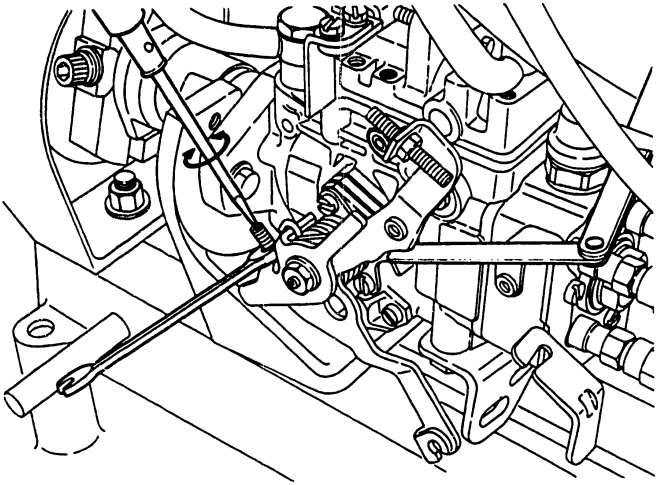


Fig. 172 Setting the adjusting screw

3. While holding the lever shaft's ball pin against the roller holder with the timer stroke at zero, adjust the M-C.S.D. lever position by turning the adjusting screw so that the distance between the stopper flange and the M-C.S.D. lever is as specified. Then, confirm the above measurement by moving the M.C.S.D. lever two or three times. (Fig. 172)

Note: Take care during this operation, as when the M-C.S.D. lever is not moved gently, the M-C.S.D. lever shaft's ball pin will move the roller holder in the advance angle direction (move the lever gently and fix it in the position where the sliding resistance changes).

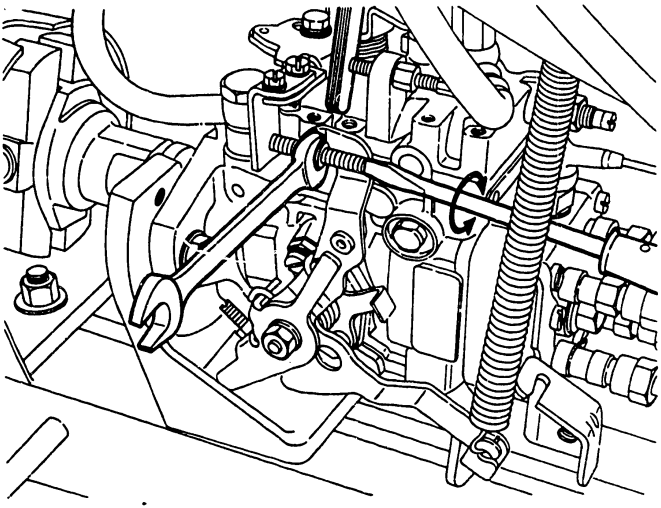


Fig. 173 Adjusting the control lever position

4. After moving the M-C.S.D. lever through its full stroke, adjust the control lever position by turning the adjusting screw so that the distance between the tip of the idle adjusting screw and the control lever is as specified. (Fig. 173)

Note: In the adjustment procedure above, after the distance between the tip of the idle adjusting screw and the control lever is adjusted to the specified value using a block gauge etc., the M-C.S.D. lever is moved through its full stroke, and the adjusting screw is adjusted so that it contacts the control lever flange.

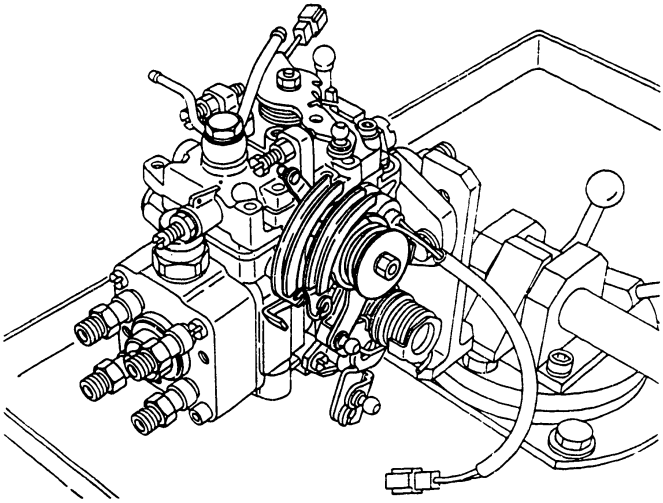


Fig. 174 Attaching the injection pump to the bracket

MANUAL-COLD START DEVICE (M-C.S.D.) (WITH SIDE LINK LEVER)

Disassembly

1. Attach the injection pump to the bracket (KDEP 2963) using the two bolts. (Fig. 174)

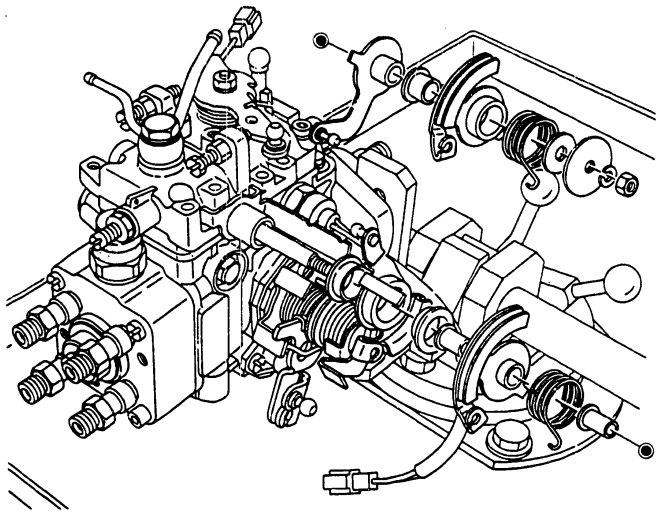


Fig. 175 Removing the nut

2. By removing the nut (74) on the tip of the shaft, the washers, springs, levers and bushings can be removed in the order shown in Fig. 175.

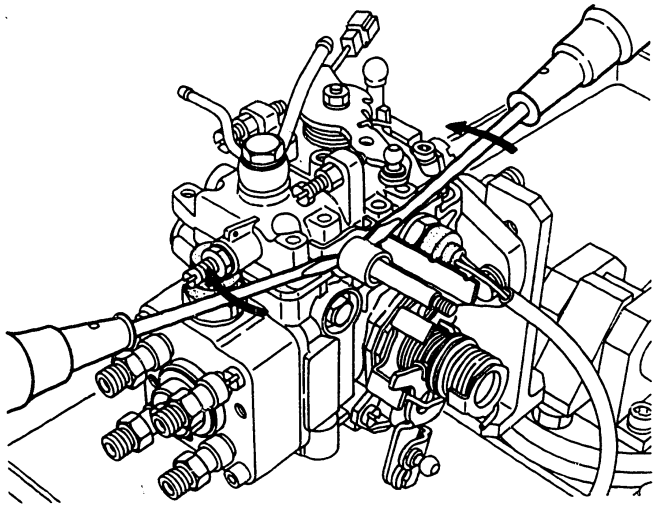


Fig. 176 Removing the bushing

3. Remove the bushing (67/27/4) by inserting two screwdrivers behind the bushing and levering it off the shaft.

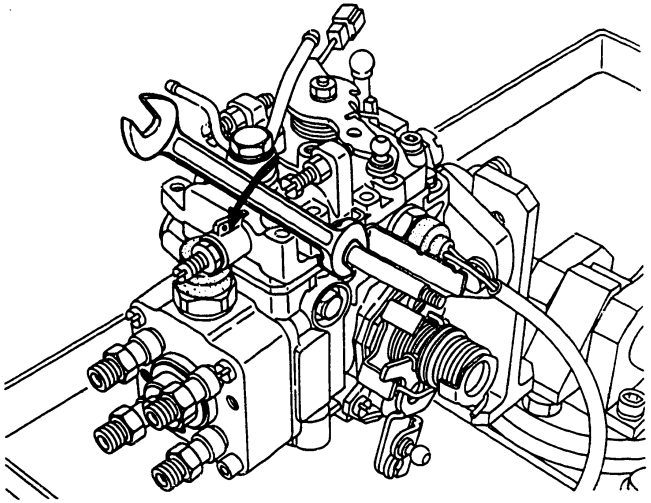


Fig. 177 Removing the shaft

4. Remove the shaft (67/27/1) together with the stopper (67/27/2).

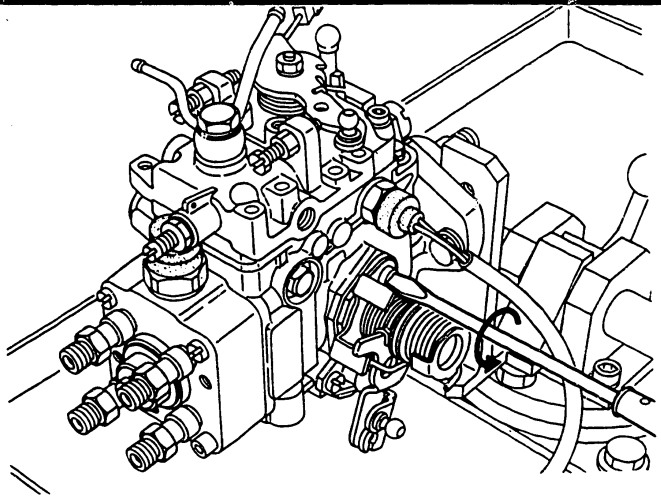


Fig. 178 Removing the M-C.S.D.

5. Remove the two screws (282) to remove the M-C.S.D. from the injection pump. (Fig. 178)

Note: As the manual-cold start device must be handled as a single component, it can not be disassembled.

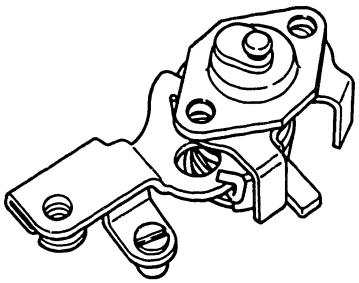


Fig. 179 M-C.S.D. assembly

Inspection

1. Check that the M-C.S.D. assembly's levers, springs, ball pin and attaching face are not worn, damaged or scratched excessively.
   Replace the M-C.S.D. assembly if defective. (Fig. 179)

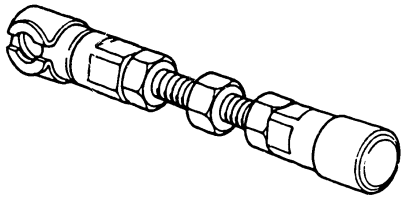


Fig. 180 Connecting rods

2. Check that the connecting rods are not damaged or bent excessively, and that the portions into which the ball pins are inserted are not worn or damaged excessively.
   Replace the connecting rods if defective.

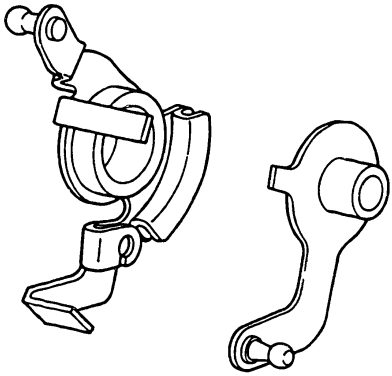


Fig. 181 Side link levers

3. Check that the side link levers are not worn, bent or damaged excessively and that their ball pins are not worn or damaged excessively. Replace the side link levers if defective.

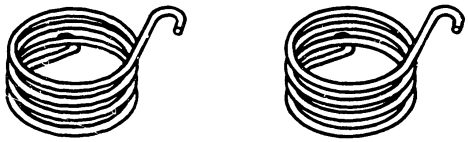


Fig. 182 Springs

4. Check that the side link lever springs are not bent, worn or damaged excessively.
   Replace the springs if defective.

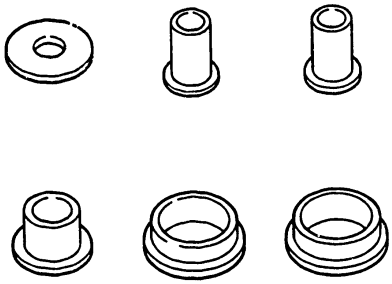


Fig. 183 Bushings

5. Check that the side link lever shaft assembly is not worn, bent or damaged.
   Replace the shaft assembly if defective.

6. Check that the side link lever bushings are not worn or damaged excessively.
   Replace the bushings if defective. (Fig. 183)

7. Inspect the other parts carefully. If they are damaged, worn, rusted or bent excessively they must be replaced.

Reassembly

The reassembly procedure is the reverse of the disassembly procedure.

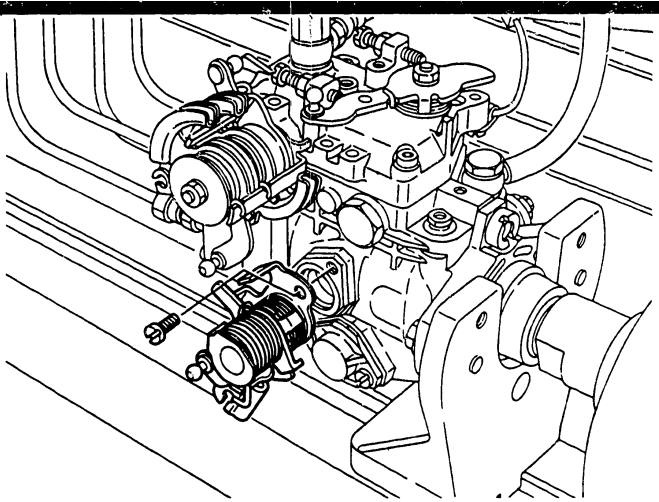


Fig. 184 Installing the M-C.S.D.

Adjustment

1. Install the M-C.S.D. in its original position after confirming that the timer stroke reading on the measuring device returns to zero when the drive shaft is rotated.
   At this time, temporarily tighten the screws fixing the M-C.S.D. (Fig. 184)

Note: During other adjustments, the M-C.S.D. is removed and the timer's high pressure side cover is installed in place of the M-C.S.D.

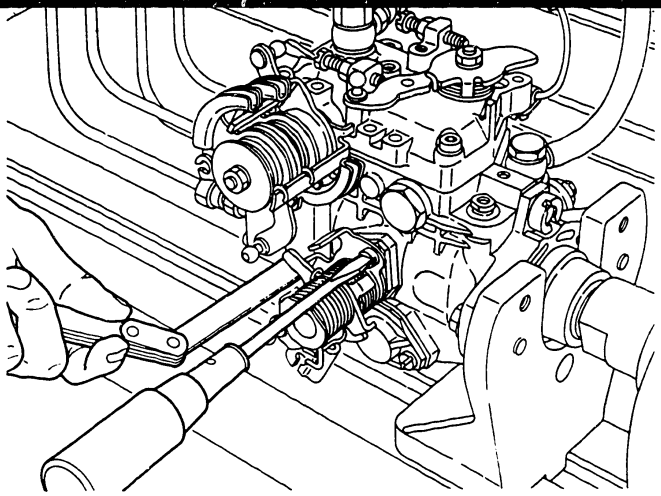


Fig. 185 Adjusting the stopper position

2. While holding the lever shaft's ball pin against the roller holder with the timer stroke at zero, adjust the stopper position using the screw in the elongated slot so that the distance between the stopper and the M-C.S.D. is as specified. Then, fix the stopper in the above position by tightening the screws and confirm the above measurement by moving the manual-cold start device two or three times. (Fig. 185)

Note: Take care during this operation, as when the M-C.S.D. lever is not moved gently, the M-C.S.D. lever shaft's ball pin will move the roller holder in the advance angle direction (move the lever gently and fix it in the position where the sliding resistance changes).

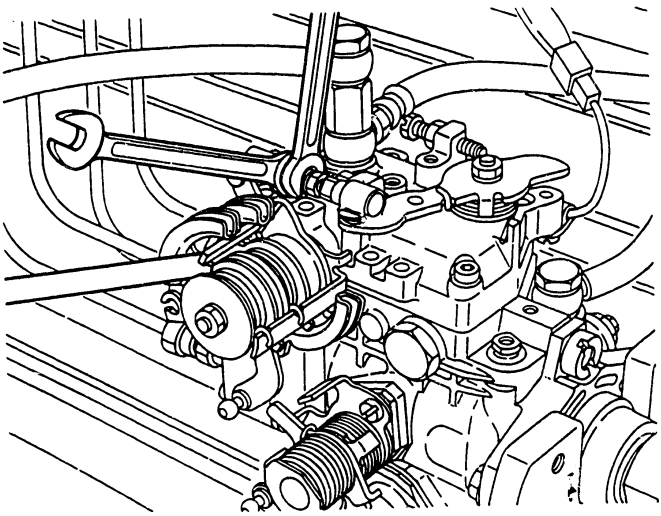


Fig. 186 Setting the adjusting rod lenght

3. Install the connecting rod (86) to connect the control lever (72) and side link lever (78).

4. While holding side link levers (79 and 81) against the stopper (67/27), adjust the connecting rod's length so that the distance between side link levers (79 and 81) and the hooked part of side link lever (78) is as specified. (Fig. 186)

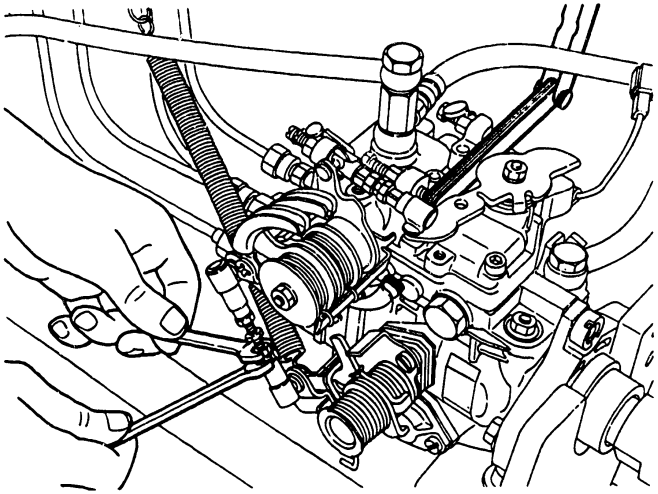


Fig. 187 Setting the adjusting rod lenght

5. After installing the other connecting rod (284) to connect the M-C.S.D. lever and side link lever (80), adjust the connecting rod's length so that the distance between the tip of the idle adjusting screw (67/15) and the control lever (72) is as specified. (Fig. 187)

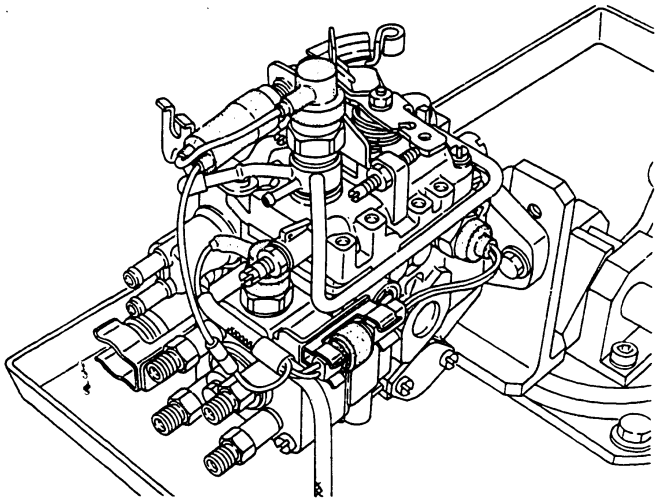


Fig. 188 Attaching the injection pump to the bracket

SOLENOID TIMER

Disassembly

1. Attach the injection pump to the bracket (KDEP 2963) using the two bolts.

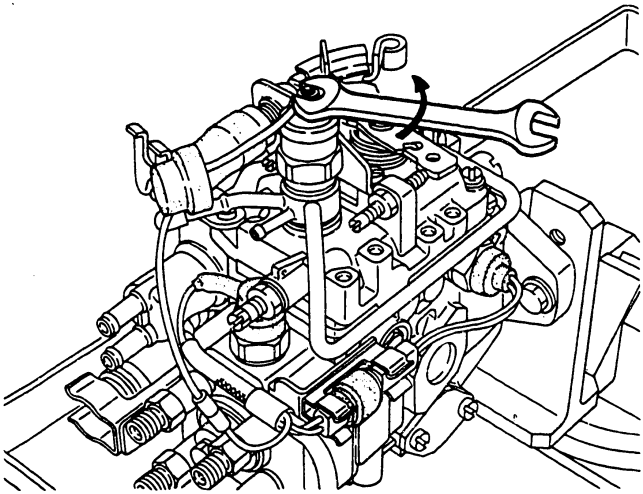


Fig. 189 Removing the nut

2. Remove the nut (145) and washer (146) from the top of the solenoid timer to disconnect the wire from the solenoid timer.

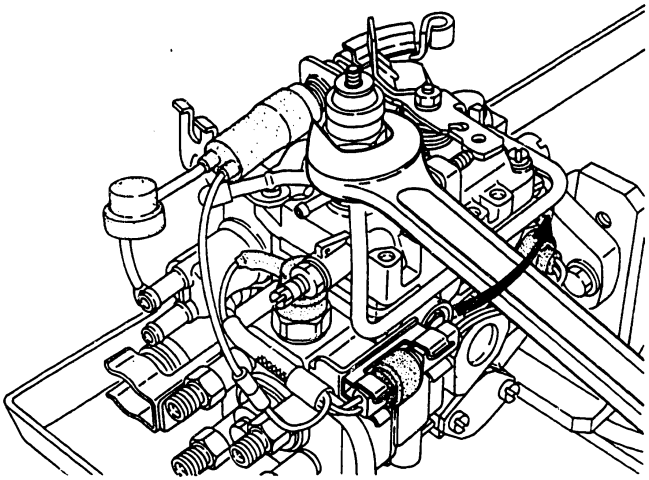


Fig. 190 Removing the solenoid timer

3. Remove the solenoid timer (136) from the injection pump.

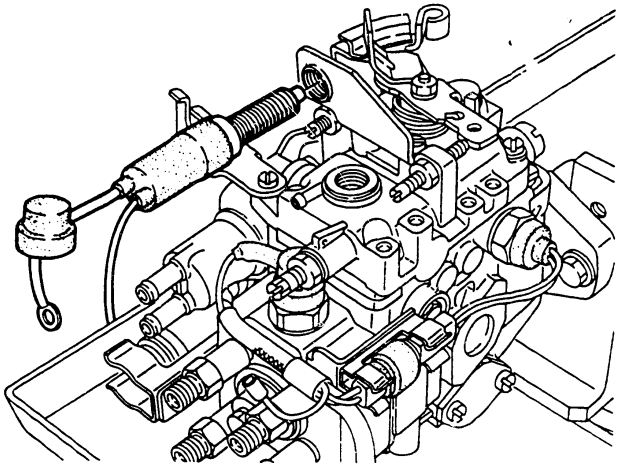


Fig. 191 Removing the accelerator switch

4. Remove the accelerator switch (223) from the bracket (230). (Fig. 191)

Note: As the solenoid timer and accelerator switch must be handled as a single component, they can not be disassembled.

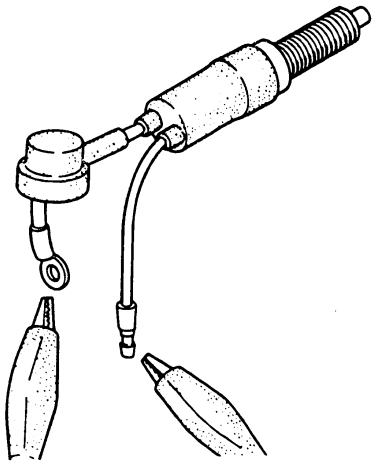


Fig. 192 Accelerator switch

Inspection

1. Connect the circuit tester to the accelerator switch and then check that the switch turns "ON" and "OFF" when the pushrod in the tip of the switch is pushed and released, respectively. Replace the switch if defective.

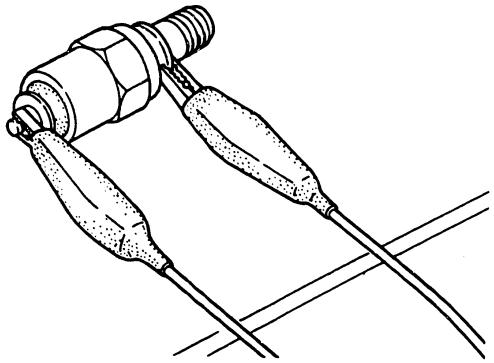


Fig. 193 Solenoid valve

2. Check the solenoid valve operation by listening for a "click" sound when the specified voltage is supplied.
   Replace the solenoid valve if defective. (Fig. 193)

3. Inspect the other parts carefully. If they are damaged, worn, rusted or bent excessively they must be replaced.

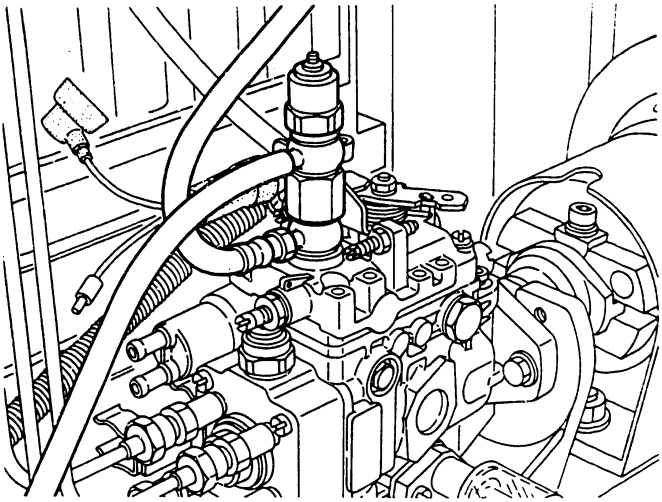


Fig. 194 Piping

Reassembly

The reassembly procedure is the reverse of the disassembly procedure.

Adjustment

1. **After installing the fuel piping using the solenoid timer (136) and the bolt (commerc. available), perform the injection pump adjustments in the same order as that of the calibration data. (Fig. 194)**

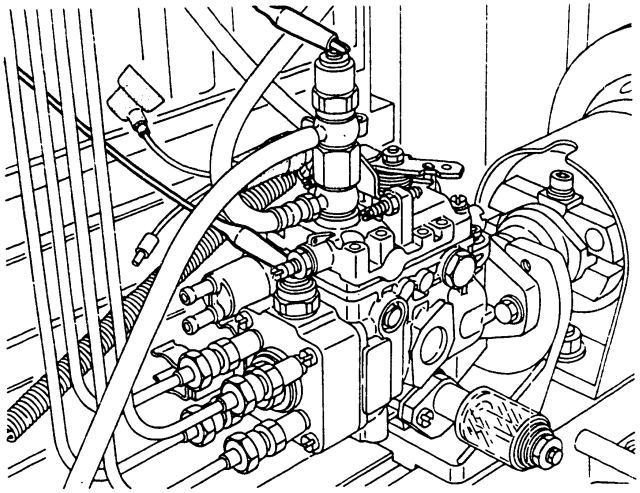


Fig. 195 Confirming the timer stroke

2. When adjusting the timer stroke, adjust the stroke using the timer's adjusting shim(s) while the specified voltage is not supplied to the solenoid timer.

3. After the above, while supplying the specified voltage to the solenoid timer, confirm that the timer stroke is as specified. (Fig. 195) If not as specified, replace the solenoid timer or readjust the timer stroke.

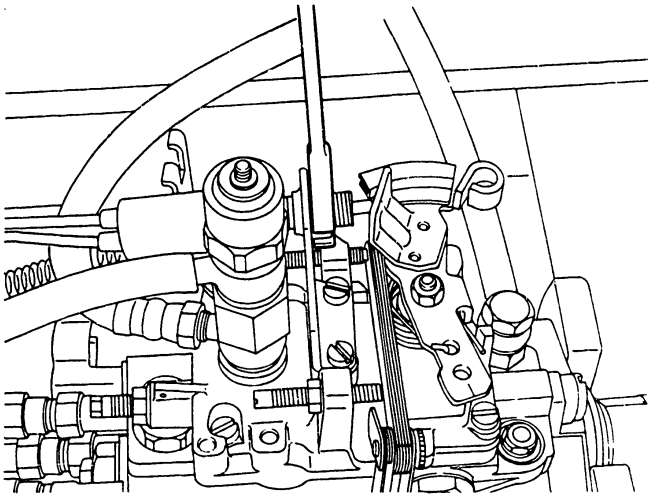


Fig. 196 Adjusting the accelerator switch position

4. When the distance between the tip of the maximum-speed adjusting screw and the control lever is as specified, adjust the accelerator switch position so that the switch is "ON", and then fix it. (Fig. 196)

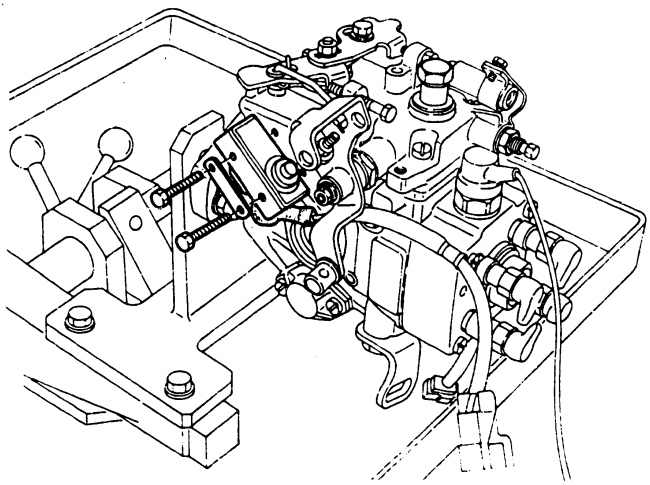


Fig. 197 Removing the microswitch

MICROSWITCH

Disassembly

The microswitch can only be removed from the bracket. To do this, remove the two bolts fixing the microswitch to the bracket. (Fig. 197)

Note: As the microswitch must be handled as a single component, it can not be disassembled.

Inspection

1. Connect the circuit tester to the microswitch and then check that the switch turns "ON" and "OFF" when the switch plunger is pushed and released, respectively.
   Replace the switch if defective.

2. Inspect the other parts carefully. If they are damaged, worn, rusted or bent excessively they must be replaced.

Reassembly

The reassembly is the reverse of the disassembly procedure.

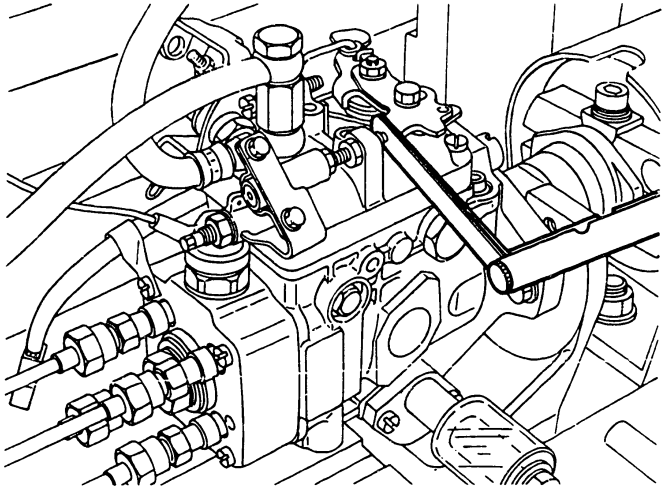


Fig. 198 Adjusting the control lever position

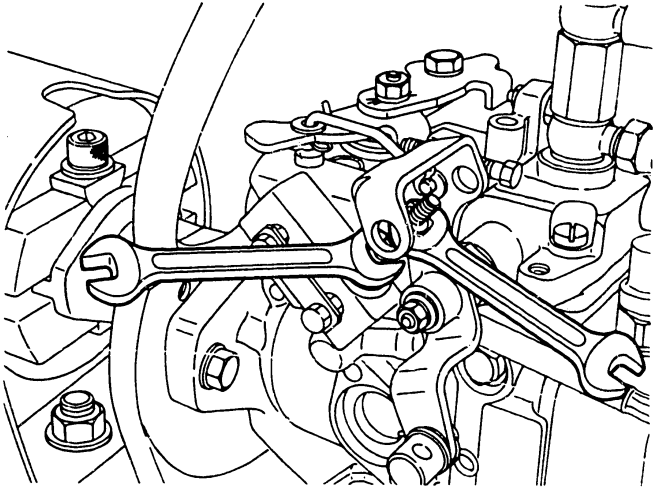


Fig. 199 Adjusting the adjusting screw

Adjustment

When the distance between the tip of the idle adjusting screw and the control lever is as specified, adjust the adjusting screw so that the microswitch is ON, or the tip of the adjusting screw contacts the tip of the microswitch plunger (as this depends on the injection pump type, perform this adjustment according to the specifications in the calibration data. (Figs. 198 and 199)

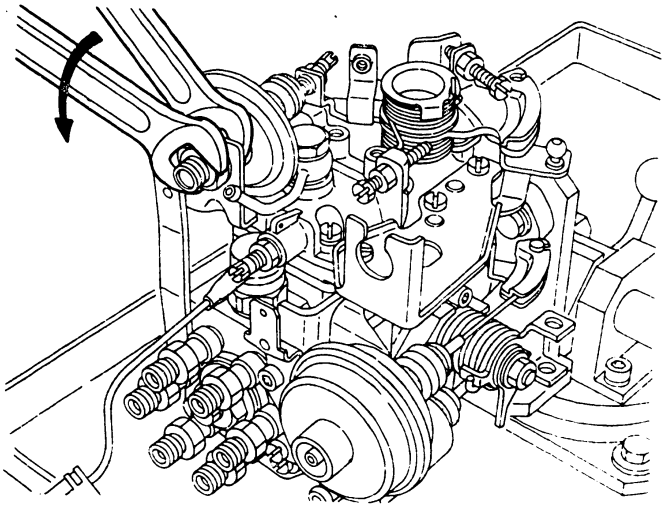


Fig. 200 Removing the dash-pot

DASH-POT

Disassembly

The dash-pot can only be removed from the bracket. To do this remove the nut fixing the dash-pot. (Fig. 200)

Note: As the dash-pot must be handled as a single component, it can not be disassembled.

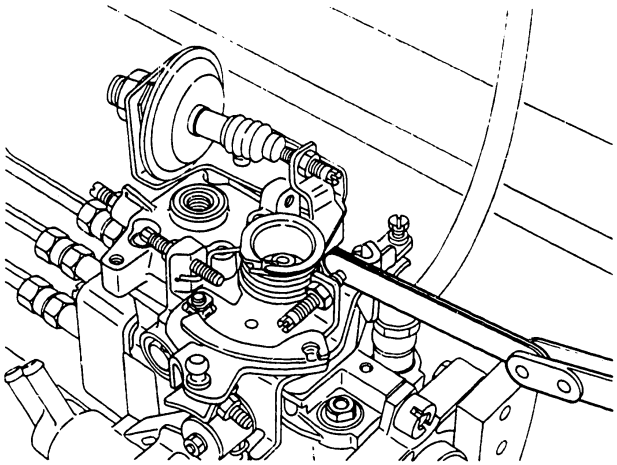


Fig. 201 Adjusting the control lever position

Reassembly

The reassembly is the reverse of the disassembly procedure.

Adjustment

1. Adjust the control lever position so that the distance between the tip of the idle adjusting screw and the bracket is as specified. (Fig. 201)

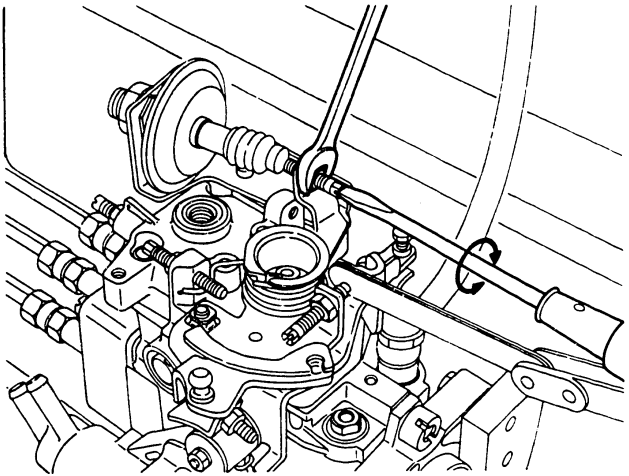


Fig. 202 Adjusting the adjusting screw

2. At this time, adjust the adjusting screw so that the tip of the adjusting screw contacts the tip of the dash-pot pushrod.

LOAD TIMER

The explanations of the disassembly and reassembly procedures have been omitted from the following as they are explained in "Disassembly" and "Reassembly" of conventional injection pumps. Therefore, the following explains only the adjustment of the load timer.

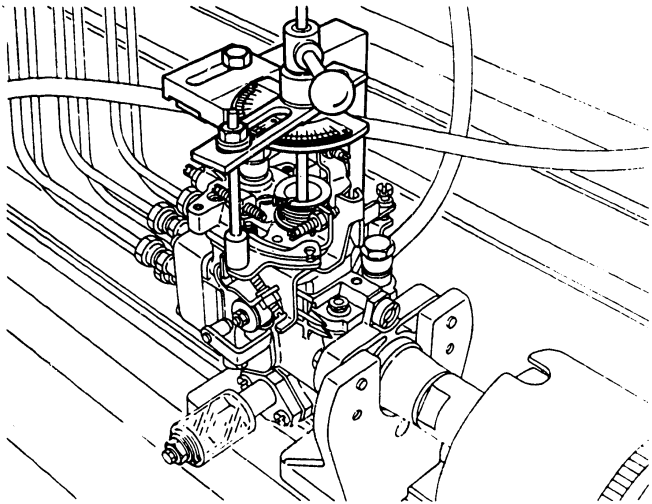


Fig. 203 Fixing the control lever

Adjustment

1. After adjusting the timer stroke, find the control lever position where the injection quantity is as specified and then fix the control lever using the measuring device **(KDDC 0018)**.

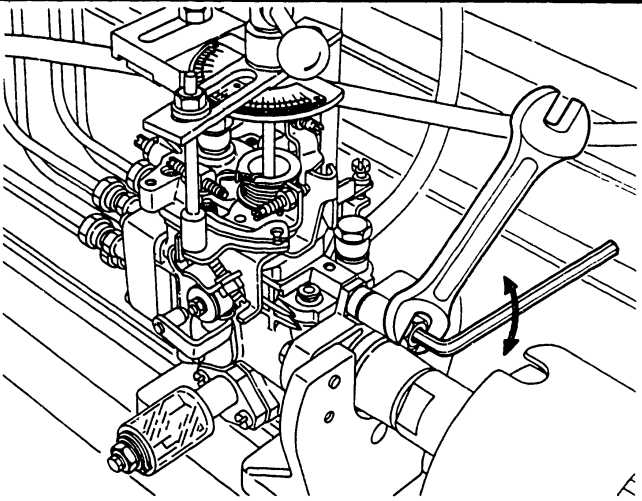


Fig. 204 Adjusting the governor shaft installation position

2. Run the injection pump at the specified speed and then adjust the governor shaft installation position so that the timer stroke is as specified.

Disassembly

1. Attach the injection pump to the bracket **(KDEP 2963) using the two bolts.**

2. Remove the control lever (72) by removing the nut (75) after marking the installation position.

3. Remove the nut (67/13) and washer (67/6) from the tip of the stop lever shaft (67/8) and then remove the stop lever (67/12), the spring (67/9), the washer (67/11) and the O-ring. (67/10).

4. Remove the stop lever shaft and washer (67/4) from the inside of the governor cover (67).

Inspection

1. Check that the stop lever shaft's sliding surface is not worn, scratched or damaged excessively and that the stop lever shaft's flange is not bent, worn or damaged excessively.
   Replace the stop lever shaft if defective.

2. Inspect the other parts carefully. If they are damaged, worn, rusted or bent excessively they must be replaced.

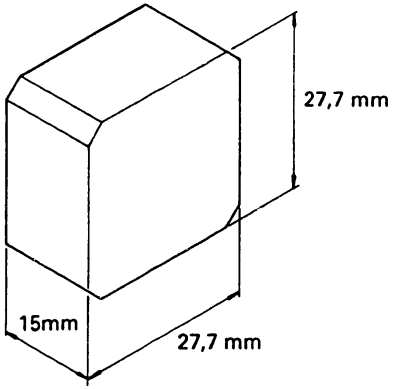


Fig. 205 Block gauge

Reassembly

During reassembly of a fuel injection pump equipped with the stop lever, a block gauge (Part No. KDEP 1130) must be used to determine the stop lever's installation position.

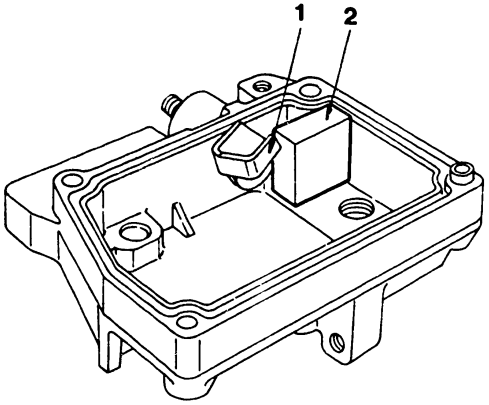


Fig. 206 Positioning the stop lever shaft

1 = Stop lever flange
2 = Block gauge

1. Using the block gauge, ensure that the distance from the inside face of the cover to the tip of the stop lever flange is 27.7 mm. Maintain the stop lever shaft in this position.

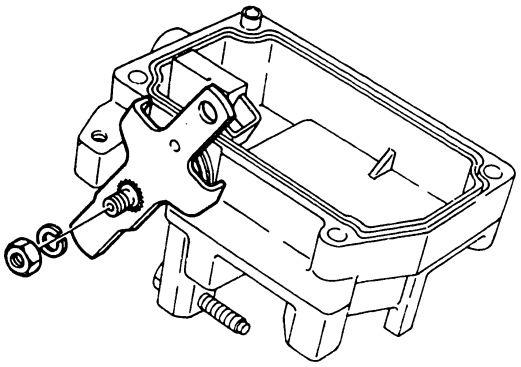


Fig. 207 Installing the stop lever

2. Install the stop lever on the stop lever shaft so that the stop lever contacts (or almost contacts) the under side of the adjusting bolt base. Then, fix the stop lever on the stop lever shaft using the washer and nut. (Fig. 207)

Note: **If the stop lever can not be installed as described above, use a stop lever with differently phased serrations.**

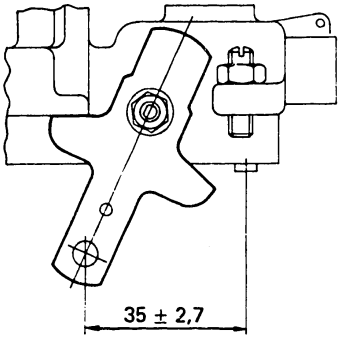


Fig. 208 Confirming the stop lever position

3. Confirm that when the stop lever is in the normal operating position, the distance from the inside face of the cover to an imaginary plane (parallel to the inside face of the cover) through the center of the stop lever reference hole is 35 to 37.7 mm.

Adjustment

As the stop lever functions to both stop the engine and adjust the fuel injection quantity at starting, there are two separate adjustment procedures

Stopping

1. Check that there is no fuel injection when the stop lever is in the "STOP" position at the specified pump speed.

2. If there is fuel injection, readjust the stop-side adjusting bolt.

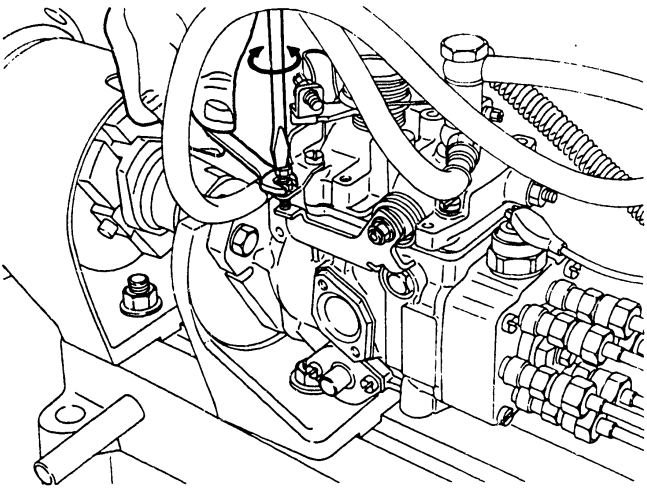


Fig. 209 Adjusting the starting injection quantity

Starting

1. Adjust the adjusting bolt on the normal operating side so that the starting injection quantity is as specified.

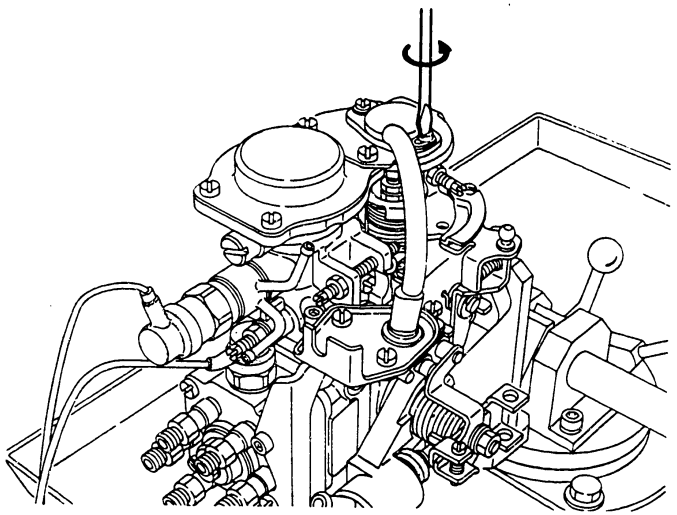


Fig. 210 Removing the screws

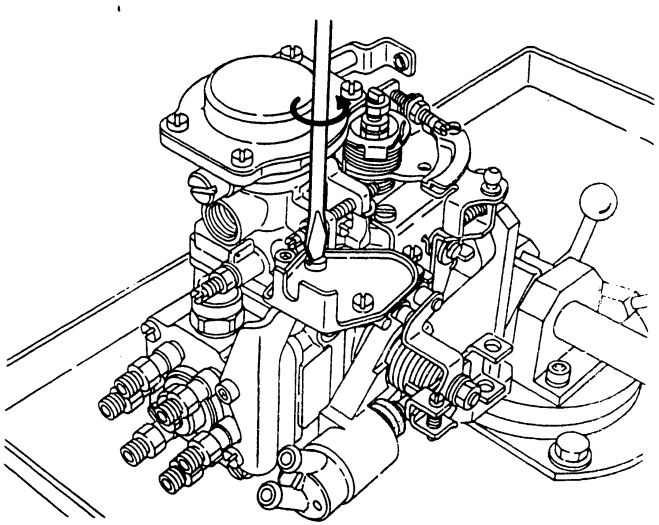


Fig. 211 Removing the bracket

POTENTIOMETER

Disassembly

The potentiometer (310/1) can only be removed from the bracket (310/2).
To do this, remove the two screws (310/4) fixing the potentiometer (310/1).
Then, remove the bracket (310/2) and joint (310/7).

Note: 1. Do not remove the adjusting bolt (310/5) unless necessary.

2. As the potentiometer must be handled as a single component, it can not be disassembled.

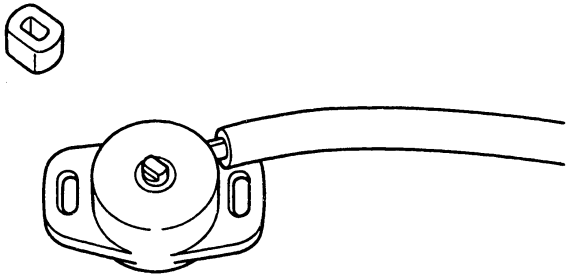


Fig. 212 Confirmation of the output voltage

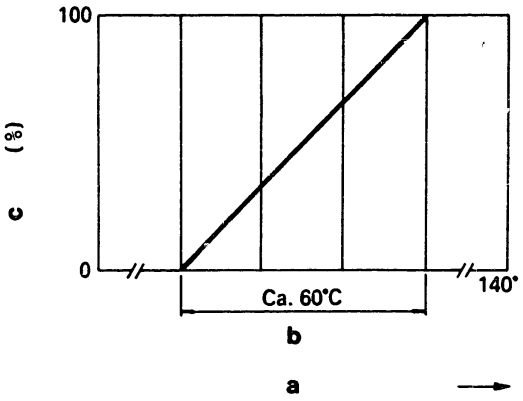


Fig. 213 Shaft rotational angle/output voltage ratio

a = Shaft rotational angle (deg.)
b = Effective electrical angle
c = Output voltage ratio

Inspection

1. Supply the specified voltage and connect the voltmeter to the potentiometer using the wire harnesses (refer to "Special Tools for Adjustment"). Then check that the potentiometer output changes linearly from approximately 0 volts to approximately the specified voltage when the pin is turned through its full stroke.

Replace the potentiometer if defective. (Figs. 212 and 213)

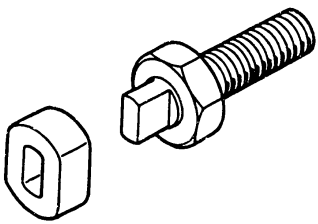


Fig. 214 Joint and adjusting bolt

2. Check that the joint is not damaged and that it is firmly connected to the pin and the adjusting bolt. (Fig. 214)

3. Inspect the other parts carefully. If they are damaged, worn, rusted or bent excessively they must be replaced.

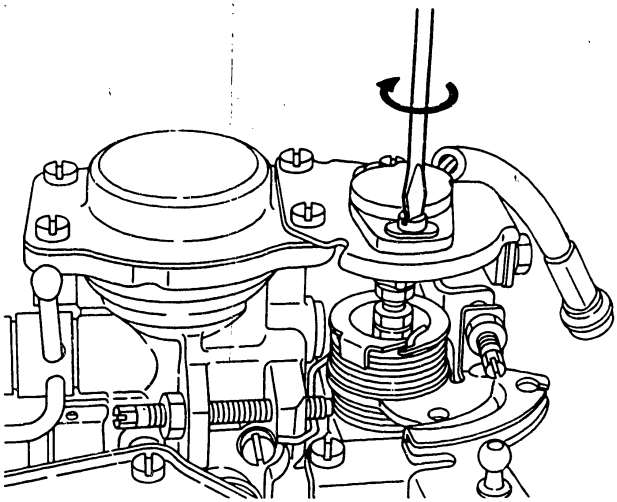


Fig. 215 Temporarily installing the potentiometer

Reassembly

If the adjusting bolt (310/5) is removed during the disassembly procedure, reinstall it as follows.

1. Temporarily install the adjusting bolt (310/5), nut (310/6) and potentiometer (310) without the joint (310/7). (Fig. 215)

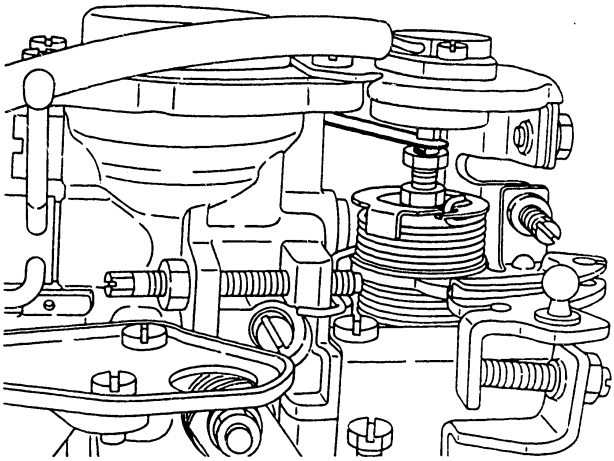


Fig. 216 Adjusting the adjusting bolt position

2. Using the thickness gauge, adjust the clearance between the tip of the potentiometer and the face of the adjusting bolt as specified in the calibration data.

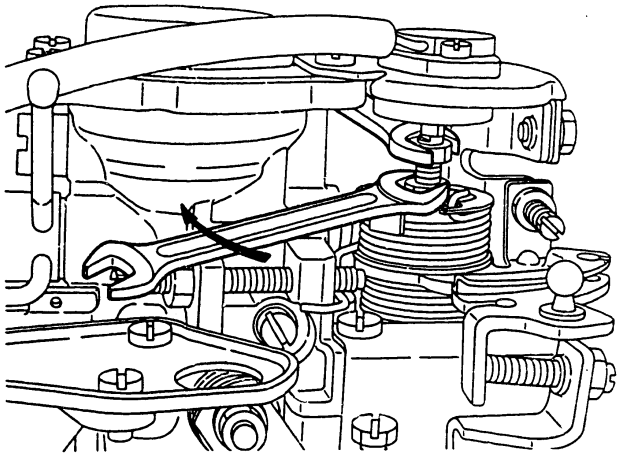


Fig. 217 Fixing the adjusting bolt

3. Fix the adjusting bolt with the nut (310/6).

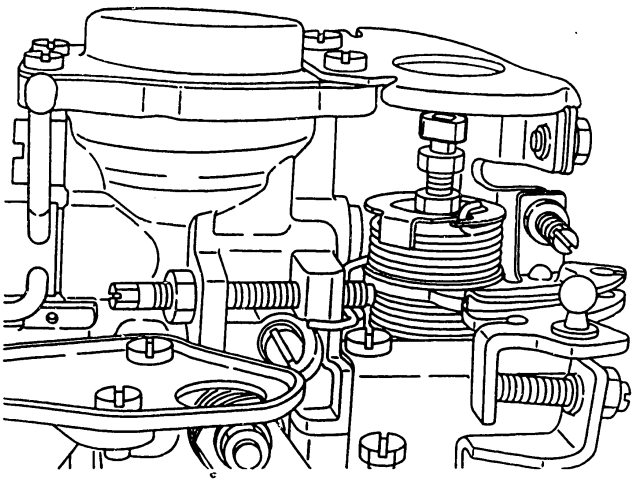


Fig. 218 Installing the joint

4. After removing the potentiometer, install the joint (310/7) to the adjusting bolt.

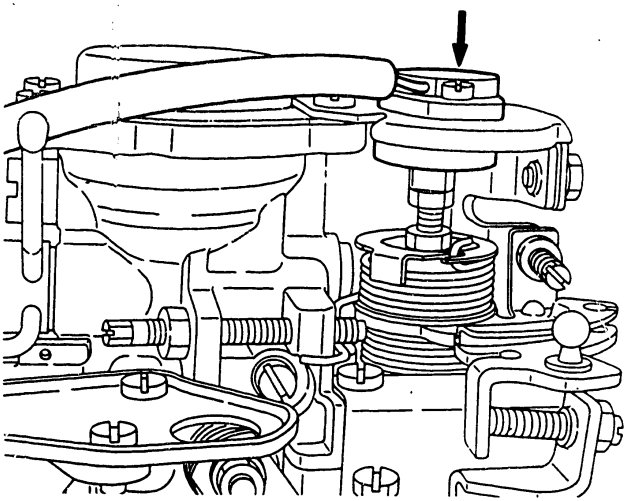


Fig. 219 Installing the potentiometer

5. Insert the potentiometer tip into the joint groove.

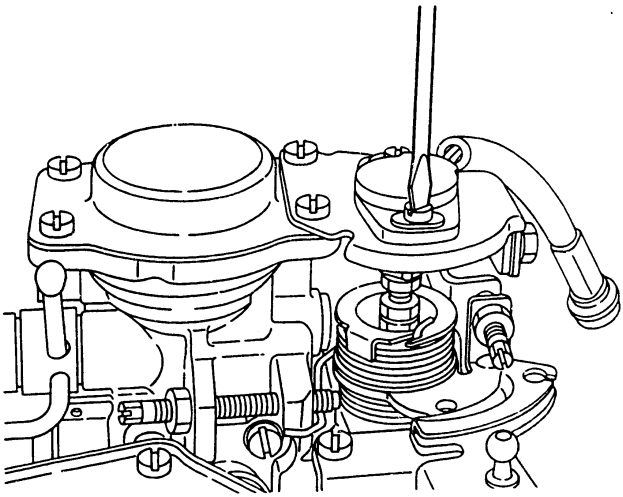


Fig. 220 Fixing the potentiometer

6. Securely fix the potentiometer to the bracket (310/2) with the bolts (310/4) and spring washers (310/3). (Fig. 220)

7. Ensure the control lever can be moved smoothly by hand.

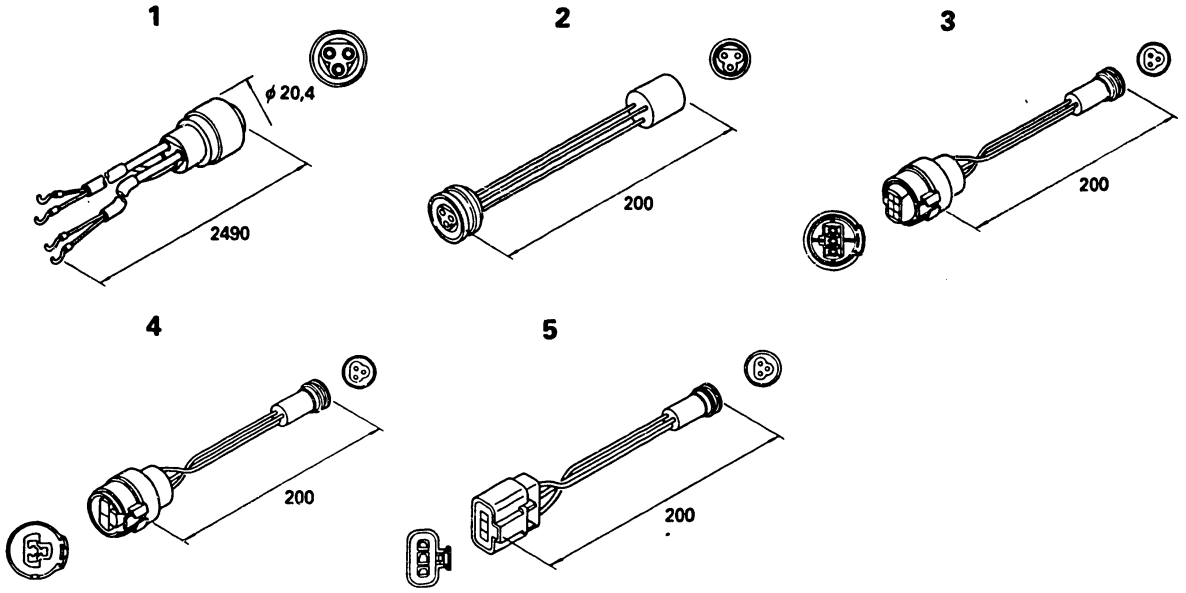


Fig. 221 Special tools for adjustment

Special Tools for Adjustment

No.	Part No.	Part Name	Q'ty	
1	KDEP 2619	Connector	1	For adjusting potentiometer.
2	KDEP 2620	Connector	1	For adjusting potentiometer used with connector (KDEP 2619).
3	KDEP 2621	Connector	1	For adjusting potentiometer used with connector (KDEP 2619).
4	KDEP 2622	Connector	1	For adjusting potentiometer used with connector (KDEP 2619).
5	KDEP 2623	Connector	1	For adjusting potentiometer used with connector (KDEP 2619).

As well as the above, a constant-voltage power supply and digital voltmeter are necessary.

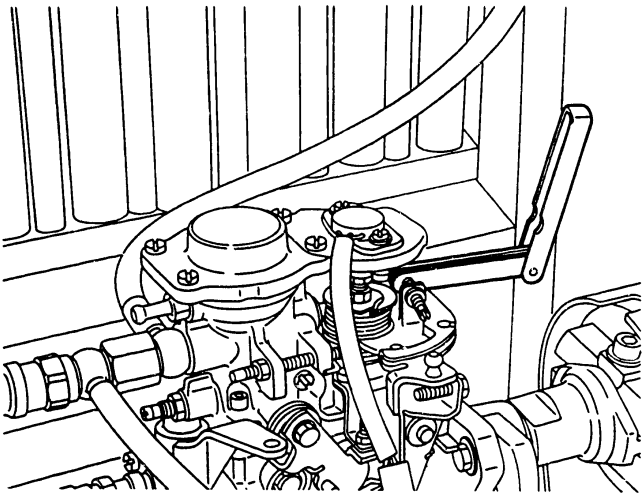


Fig. 222 Measuring the injection quantity

Adjustment

1. After adjusting the control lever position so that the distance between the tip of the idle adjusting screw and the control lever is as specified, measure the injection quantity at the specified injection pump speed. (Fig. 222)

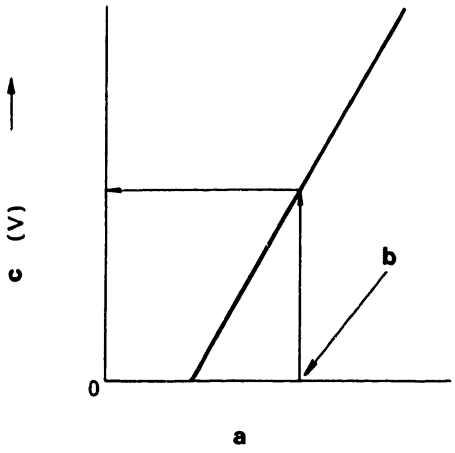


Fig. 223 Output voltage/injection quantity

a = Injection quantity (cc/1,000st)
b = Measured value
c = Output voltage

2. Find the output voltage of the potentiometer using the injection quantity value, measured above, and the characteristic graph in the calibration data indicating the relationship between the output voltages of the potentiometer and the injection quantity values. (Fig. 223)
3. Connect the potentiometer, the digital voltage meter and the constant-voltage power supply using the wire harness.

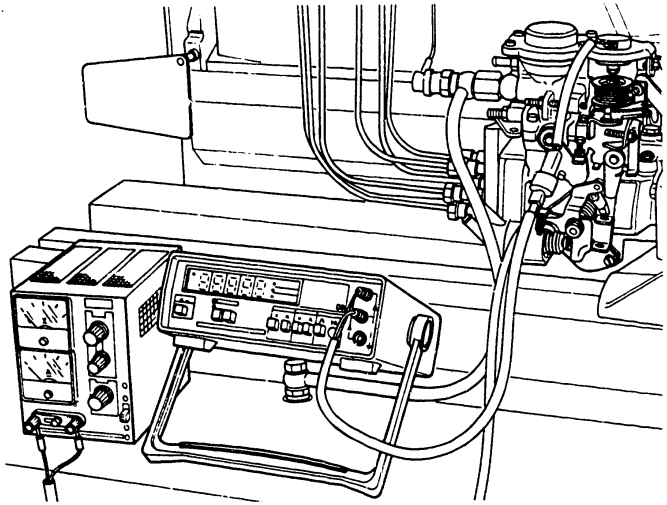


Fig. 224 Supplying the voltage

4. Supply the specified voltage to the potentiometer after confirming that the output voltage of the power supply is exactly as specified.

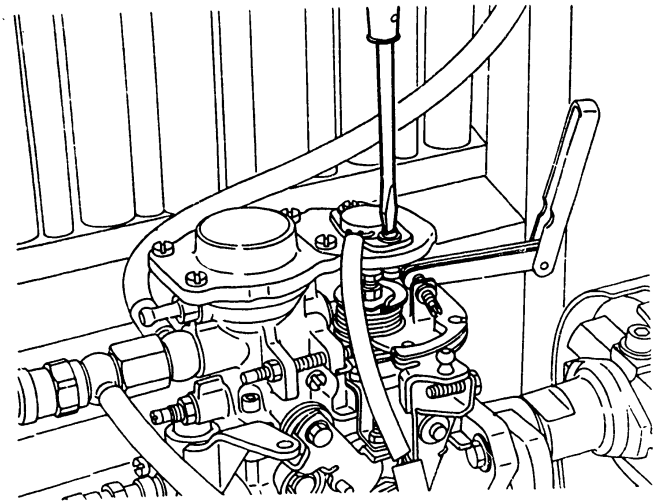


Fig. 225 Adjusting the potentiometer position

5. Adjust the potentiometer position using the elongated slot so that its output voltage is as specified in the characteristic graph (item 2 above).

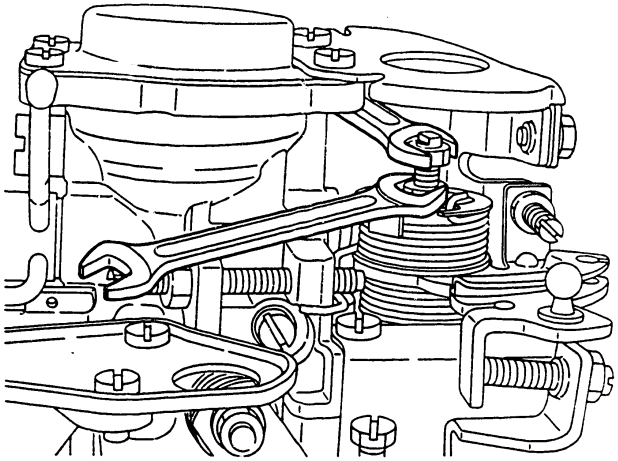


Fig. 226 Resetting the adjusting bolt position

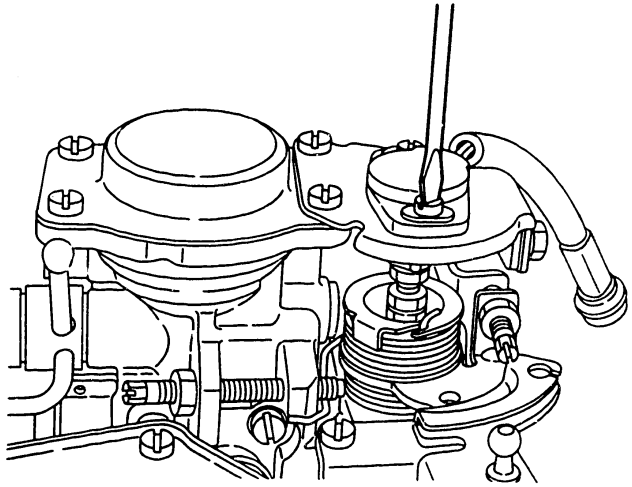


Fig. 227 Readjusting the potentiometer position

6. If it cannot be adjusted using only the elongaged slot, reset and fix the adjusting bolt position and then readjust the potentiometer position (refer to item 5). (Figs. 226 and 227)

7. After adjustment of the potentiometer, ensure the control lever is moved smoothly to the idling position by its return springs.

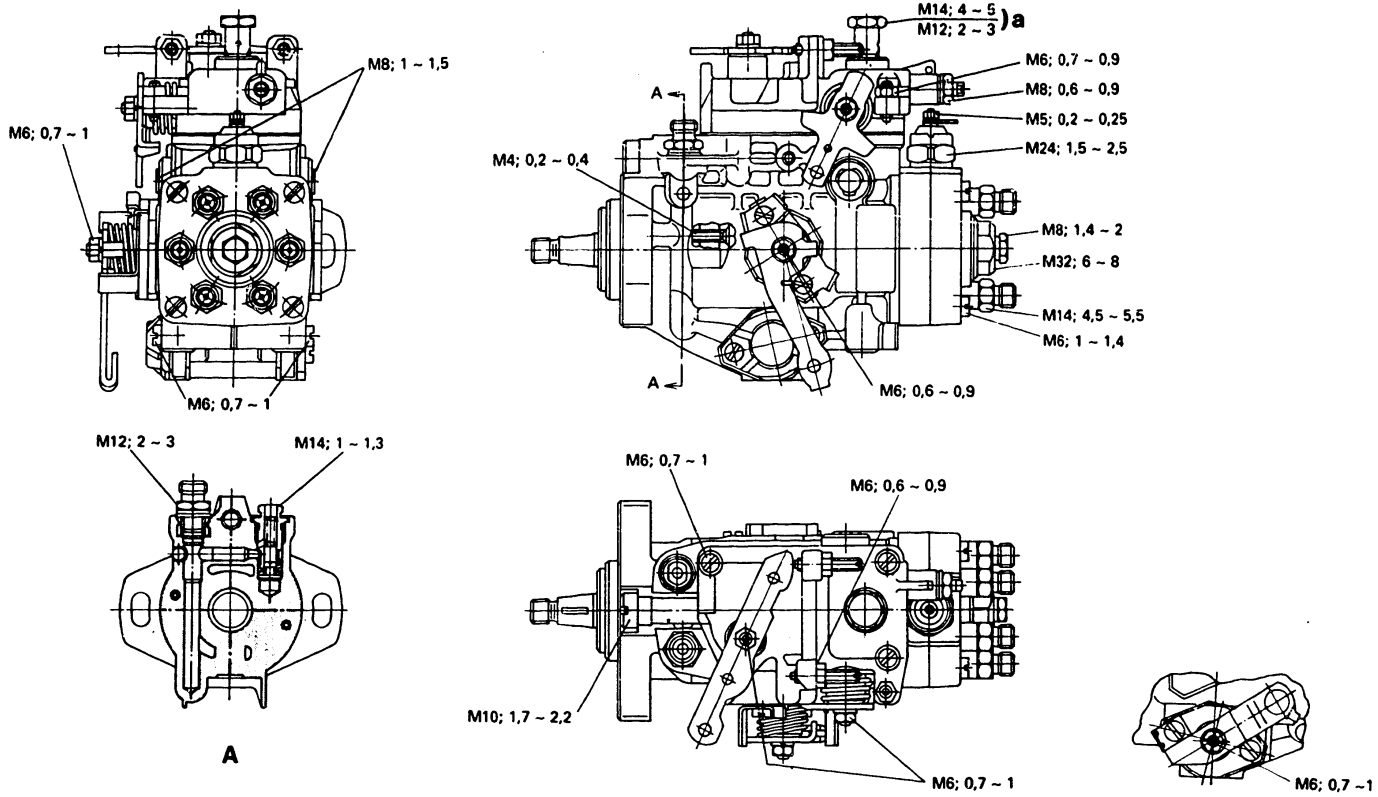


Fig. 228

a) = (with hose joint)
A = Section A-A

Unit: kg-m

TIGHTENING TORQUE

K21 Tightening torque
Fuel injection pump (VE)

K22 Tightening torque
Fuel injection pump (VE)

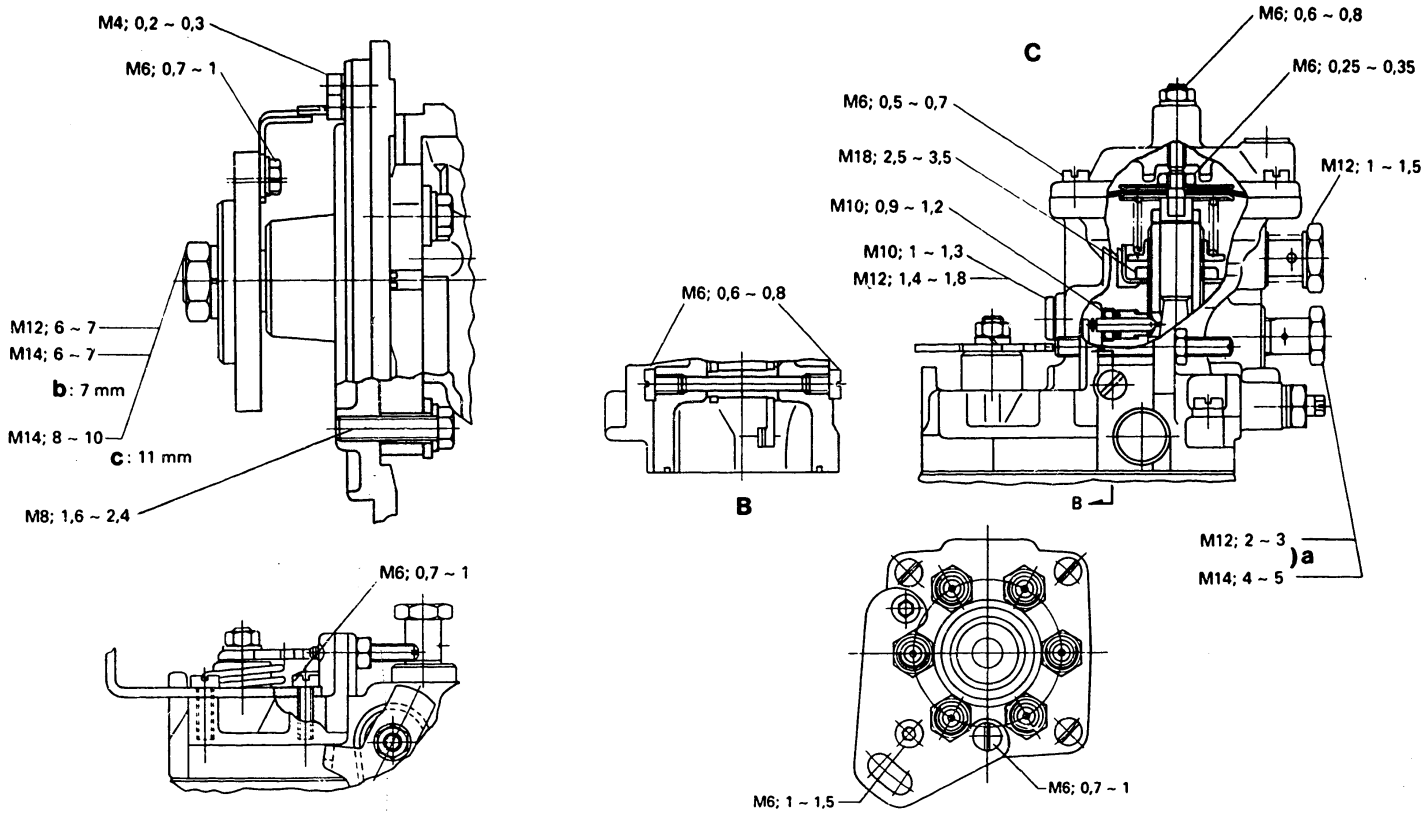


Fig. 228-1

a = (with hose joint)

b = Thickness of joint

c = Thickniss of joint

Tightening torque

B = Section B-B

C = Boost compensator

Unit: kg-m

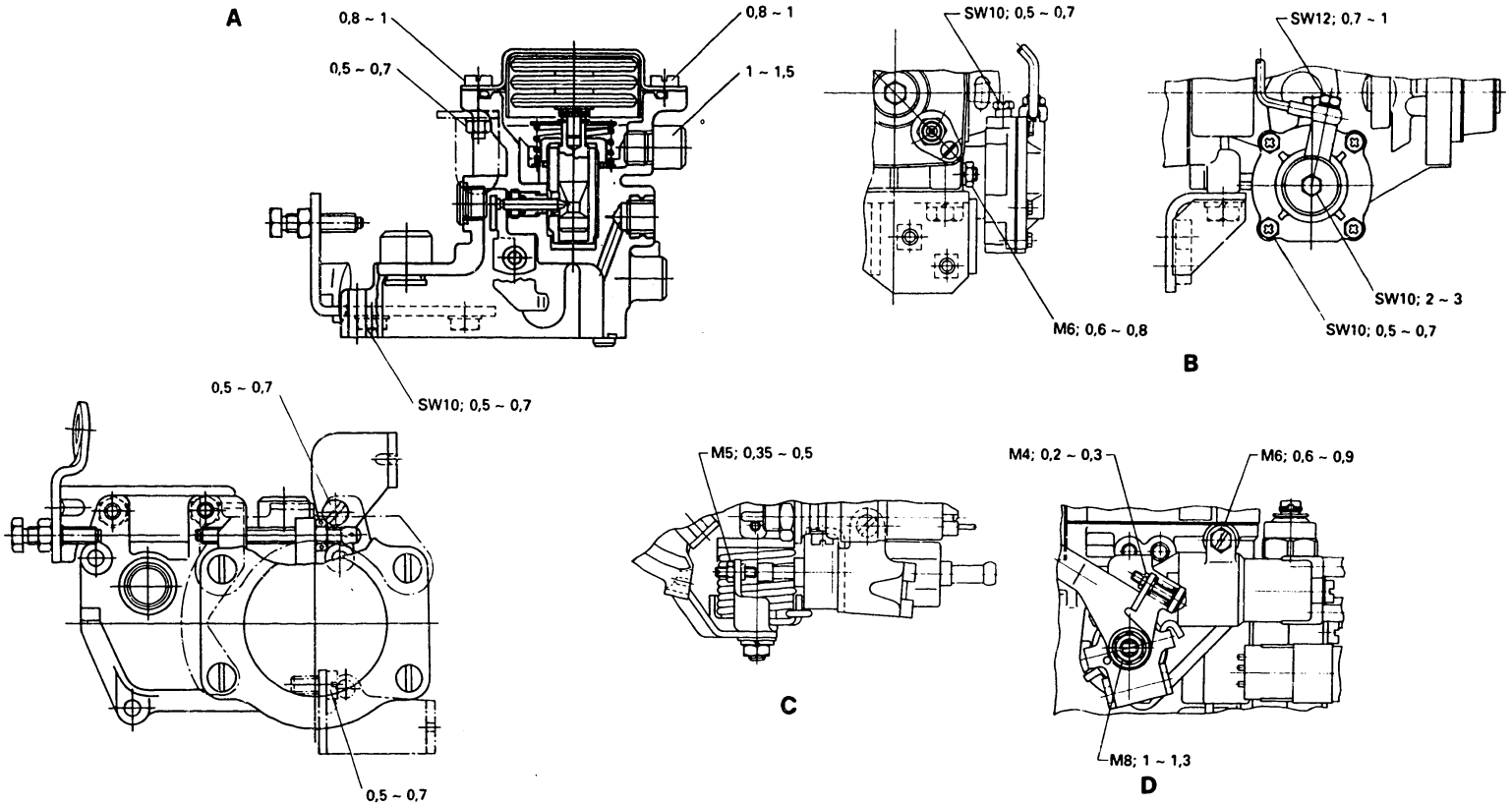


Fig. 228-2

Tightening torque

Unit: kg-m

A = Aneroid compensator
B = CSD
C = W-CSD
D = M-CSD

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